MYCOLOGIA

OFFICIAL ORGAN OF THE MYCOLOGICAL SOCIETY OF AMERICA

VOL. XXXV MAY–JUNE, 1943 NO. 3

THE STATUS OF SEPTORIA ALOPECURI AND SOME RELATED SPECIES [1]

RODERICK SPRAGUE [2]

(WITH 1 FIGURE)

Karsten originally listed *Septoria Bromi* Sacc. var. *Alopecuri* Karst. on *Alopecurus pratensis* L. from Finland (3, p. 151). In Karsten's inadequate description, the pycnidia were listed as 80–100 μ diameter, not in spots, with dilutely flavid spores, 58–65 $\times$ 2.5–3 μ. The fungus, therefore, had definitely stouter spores than *S. Bromi* Sacc. to which it very evidently shows no great similarity (**6**). P. Sydow (**8**, p. 138) raised the variety to species rank. He said that the spots were obsolete to elongate, pycnidia numerous, black, 80–100 μ; spores bacillar, pluriseptate, rather obtuse, hyaline to dilutely yellow, straight to slightly curved, 50–65 $\times$ 2.5–3.5 μ, on *Alopecurus aequalis* Sobol (*A. fulvus* J. E. Smith). H. Sydow very kindly sent the writer a fragment of this collection (Myc. March. *4,871* Zehlendorf, near Berlin, German, Aug. 3, 1896). It appears that the fungus is close to *Hendersonia crastophila* Sacc. (**4**). This species was originally described by Saccardo (**4**, p. 211) as having two forms: "1. *Phragmites com-*

[1] Coöperative investigations between the Divisions of Cereal Crops and Diseases, Forage Crops and Diseases, Dry Land Agriculture, Bureau of Plant Industry, Agricultural Research Administration, Division of Nurseries, Soil Conservation Service, United States Department of Agriculture; and the Oregon and North Dakota Agriculture Experiment Stations. Published with the approval of the Director of the Oregon Agricultural Experimental Station as Technical paper 409.—Contributed from the Department of Botany.

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[MYCOLOGIA for March–April (**35**: 133–257) was issued April 1, 1943]

munis: stylosporis bacillari-fusoideis, utrinque rotundatis, 35 × 5.5, 7–8-septatis, eguttulatis, fuligineis. 2. *Cynodontis dactyli:* stylosporis similibus, 35 × 4." Later, Saccardo (**5**, p. 438) designated the former as *H. crastophila* Sacc. and the latter as "var. *β Cynodontis dactyli*"; both with descriptions, including spore measurements, as above.

Most of the European and American material otherwise assignable to *Hendersonia crastophila* has 7-septate, fusoid brown spores, usually 40–60 × 3–4.5 μ, but which are sometimes narrower, depending on the host or stage of development. Sydow's specimen has narrower spores than most of *H. crastophila* (FIG. 1, D, E, F). Sydow's material that we examined has spores 40–49 × 3.4–4.2 μ, and, therefore, shorter and wider than the measurements given by Sydow. It is possible, therefore, that the portion we saw was not typical of the fungus he was discussing.

Karsten's type is not available and there is no way of telling from his description whether he had a true *Septoria*, *Phaeoseptoria* (**7**) or simply a phase of *Hendersonia crastophila*. The evidence indicates that his fungus was more likely an undeveloped *Hendersonia*. The lack of evident lesions, the size of the pycnidia and the yellow spores are all indicative of developing *Hendersonia* material. However, we have recently encountered material on grasses from the United States that may be related to Karsten's fungus, but which are logically assigned to *Septoria*.

C. L. Lefebvre sent material of *Septoria Andropogonis* J. J. Davis on *Andropogon furcatus* Muhl. collected at Manhattan, Kansas, which had 2 to 3-septate hyaline to yellow, obclavate spores 33–51 × 3.2–3.9 μ (FIG. 1, B). Davis' type (**1**) has spores 30–50 × 2–3 μ, but otherwise was like Lefebvre's collection. Davis' species has spores that range in size below those of *S. Alopecuri*, but possibly has spores similar to those Karsten saw. We have another collection on *Sporobolus heterolepis* A. Gray, which is very similar to *S. Andropogonis* and which we are designating a new form, as follows:

Septoria Andropogonis Davis forma **sporobolicola** forma nov.

Spots oval to sub-elongate-elliptical, small, 1–3 mm., scattered in living, vigorous leaves, white to straw colored with narrow but well defined anthocyaninred borders, pycnidia 2 to several in each

spot, strongly erumpent, almost superficial, pale brown, thin-walled, somewhat elongate but depressed-globose, ostiolate, 120–150 × 100–140 μ; pycnospores hyaline but becoming yellow in saprophytic stage, contents with few small, not prominent, guttulae more or less adjacent to the cross walls, basal cell tapering, blunt or sub-truncate spores stiffly curved or nearly straight,

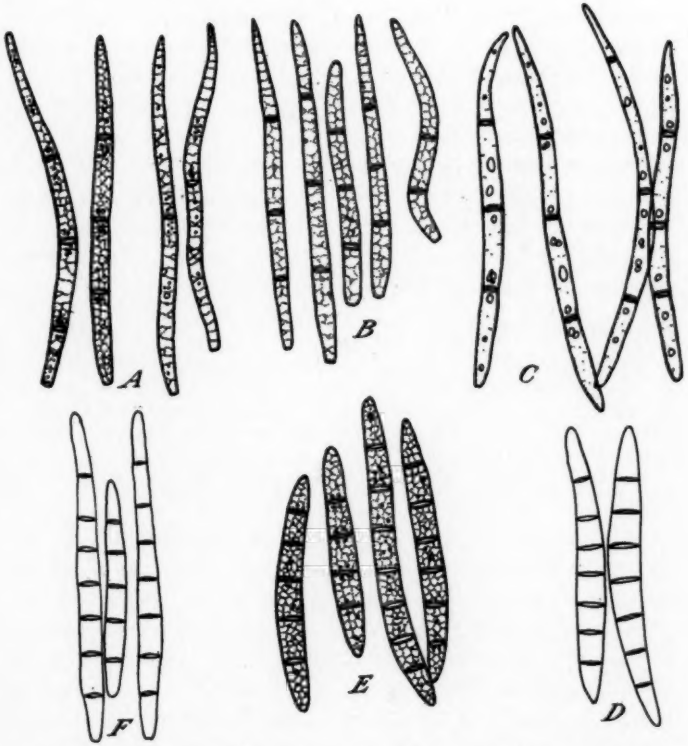

FIG. 1. *A*, *Septoria Andropogonis* Davis f. *sporobolicola* on *Sporobolus heterolepis* near Lisbon, N. Dak. 1939. (Watson coll., Mandan N-1818); *B*, *S. Andropogonis* Davis on *Andropogon furcatus*, Manhattan, Kansas. (C. L. Lefebvre coll.); *C*, *Septoria mississippiensis* on *Muhlenbergia mexicana*, Lake Itasca at head-waters of Mississippi river, Minn. (Type); *D*, *Hendersonia crastophila* Sacc. on *Calamagrostis canadensis* var. *scabra*, Seward, Alaska; *E*, *H. crastophila* on *Agropyron Smithii*, Clyde, N. Dak.; *F*, *Septoria Alopecuri* (Karst.) Sydow on *Alopecurus aequalis* (Myc. March. *4871*, Berlin, Germany). All × 1000.

obclavate, apex sharp-pointed, 45–51 × 2.4–3.4 μ; spores typically about 50 × 2.6 μ in spot material, broader in saprophytic material, 3-septate.

On living leaves of *Sporobolus heterolepis* in Land Utilization project near Lisbon, N. Dak., Sept. 15, 1939, collected by Welland A. Watson (Mandan *N-1818*) (*B.P.I. 80,859*). This form differs from the species in having larger pycnidia and smaller, more or less circular nonstriate lesions. On the basis of present knowledge, f. *sporobolicola* is nothing more than a morphological form of *S. Andropogonis*, but host range studies are needed to determine physiological relationship.

Another specimen on *Muhlenbergia mexicana* (L.) Trin., which has spores 35–65 × 2.1–3.1 μ, may be even closer to *S. Bromi* var. *Alopecuri*. Considering the confusion about Karsten's fungus, it is considered better to recognize the fungus on *Muhlenbergia mexicana* as an undescribed species as follows:

Septoria mississippiensis sp. nov.

Maculis orbiculatis v. elongatis, flavo-brunneis, margine brunneo, pycnidiis paucis, sub-gregariis, subcarbonaceo-parenchymaticis, erumpentibus, ostiolatis, parvulis, nigro-brunneis, 100–113 μ; pycnosporulis hyalinis v. chlorinis, clavulato-filiformibus, apicibus subacutis, basibus subobtusis, 3-septatis, guttulatis, 35–65 × 2.1–31. μ.

Hab, in foliis vivis *Muhlenbergiae mexicanae* (L.) Trin., Lake Itasca, Minn. Type is *B.P.I. 80, 857*.

This material consists of only a few but well defined buff eyespots with prominent brown borders on the sheaths and leaves of living or sometimes necrotic leaves of this host. This fungus is possibly a phase of *Phaeoseptoria Festucae* f. *Muhlenbergiae* Spr. (7), but this is unlikely because the spores of *S. mississippiensis*, which appear to be mature or nearly so, are much paler and narrower than the *Phaeoseptoria*. The lesions are distinct and the pycnidia of the *Septoria* smaller with thinner walls. *S. mississippiensis* is, as mentioned, possibly close to *S. Bromi* var. *Alopecuri* but certainly not to *H. crastophila* (cfr. FIG. 1, A–F). Our fungus is named for the Mississippi river from whose very headwaters this specimen was obtained in 1941. Recently a second collection of *S. mississippiensis* on *M. asperifolia* (Nees and Mey.) Par. (*B.P.I. 80,858*) was obtained near New Rockford, N. Dak.

The several forms of *S. Alopecuri* first discussed by Trail (**9**) and enlarged on by Grove (**2**) are discussed in a companion article to this on the genus *Phaeoseptoria* (**7**) to which genus these forms are transferred.

Again the aid of A. G. Johnson and Edith Cash in the final preparation of the manuscript is gratefully acknowledged.

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LITERATURE CITED

1. **Davis, J. J.** Notes on parasitic fungi in Wisconsin—1. Wisc. Acad. Sci. **18**: 78–92. 1915.
2. **Grove, W. B.** British stem- and leaf-fungi (Coelomycetes) Sphaeropsidales. **1**, 488 pp. illus. Cambridge. 1935.
3. **Karsten, P. A.** Symbolae ad mycologiam fennicam XVI. Medd. Soc. Faun. Fl. Fenn. **11**: 148–161. 1884.
4. **Saccardo, P. A.** Fungi Veneti novi vel critici vel mycologiae Veneti addendi, VII. Michelia **1**: 133–221. 1878.
5. ——. Sylloge Fungorum **3**: 562. Pavia. 1884.
6. **Sprague, R.** *Septoria* diseases of Gramineae in the Western United States. (In ms.)
7. ——. The genus *Phaeoseptoria* on grasses in the western hemisphere. (In ms.)
8. **Sydow, P.** Beitrage zur kenntniss der Pilzflora der Mark Brandenburg II. Hedwegia (Beiblatt) **38**: 134–140. 1899.
9. **Trail, J. W. H.** Revision of Scotch Sphaeropsideae and Melanconieae. Scot. Nat. (N.S. v. 3) **9**: 219–236. 1888.

NEW STATIONS FOR TWO FUNGI

DAVID R. SUMSTINE

(WITH 1 FIGURE)

In collecting fungi in the State of New York during July, 1942, I found a rust near Bemus Point on *Potentilla recta* L. which proved to be *Phragmidium Ivesiae* Syd. Dr. Frank D. Kern of Pennsylvania State College confirmed the determination. Dr. Kern, after receiving my specimens, examined some of the host plants growing in the vicinity of State College and found them infected with the same rust. This rust is reported in the North American Flora only from the western part of the United States. *Potentilla recta* is not given as a host. It appears that these collections extend the range of this rust to the eastern part of the United States and add another host to the list.

In September, 1940, I found a number of dark brown sclerotia under some shrubbery in Schenley Park. These were evidently exposed by recent heavy rains. The place was frequently visited during the remainder of 1940 and during the year 1941 but no fruiting bodies appeared. In September, 1942, an abundance of sporophores were found not only in this particular place but also in other nearby places. The first few plants pulled up showed long root-like strands. Through curiosity I dug up some of the plants to find the place of attachment and discovered that all the plants were attached to sclerotia. (See FIGURE 1.) This collection numbers over 150 plants. Did these plants continue for two years in the resting stage?

From the published descriptions and the illustrations this plant agrees with *Naucoria arvalis* var. *tuberigena* Quél. (**1**). Lloyd (**2**) described *Naucoria scleroticola* as a new species from specimens received from West Virginia but suggested that it may be *Naucoria semiorbicularis* growing from a sclerotiun. Later (**3**) at the suggestion of Lange he decided that his new species was the same as *Naucoria arvalis* Fr. which at times develops sclerotia. Hennings (**4**) described a new species under the name *Naucoria*

tuberosa which Singer (**5**) transferred to another genus, *Agrocybe tuberosa* (Henn) Singer. Singer (loc. cit.) gives a very good description of the species. He cites Quélet's var. *tuberigena* as a synonym.

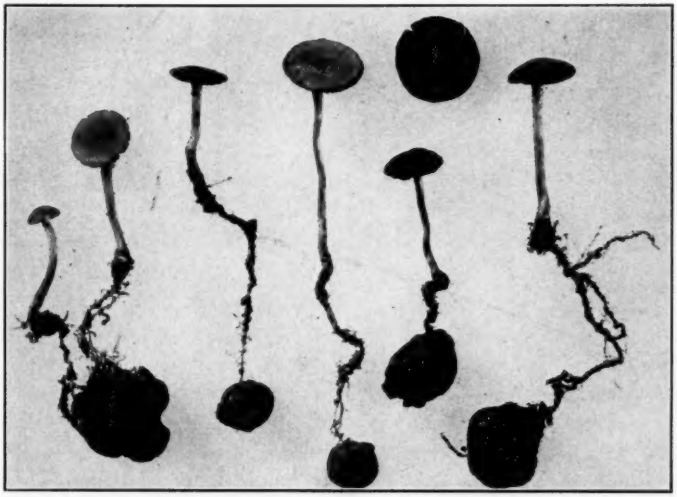

FIG. 1. Sporophores of *Naucoria tuberosa* attached to sclerotia, one-half Natural size.

It seems that the following names have been given to this plant:

Naucoria arvalis var. *tuberigena* Quél. (1889)

Naucoria tuberosa Henn. (1903)

Naucoria scleroticola Lloyd (1917)

Agrocybe tuberosa (Henn) Singer (1942)

Murrill in the North American Flora does not recognize this species.

The Pittsburgh specimens are given as a new station for this interesting plant.

The photograph from which the plate was made was taken by Sydney Prentice of the Carnegie Museum.

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LITERATURE CITED

1. **Quélet, L.** Assoc. Fr. Av. Sci. Compte Rendu **18**. 1889.
2. **Lloyd, C. G.** Mycological Notes **5**: 722. 1917.
3. **Lloyd, C. G.** Mycological Notes **5**: 753. 1917.
4. **Hennings, P.** Hedwigia **42** Beiblatt: 311. 1903.
5. **Singer, Rolf.** Lloydia **5**: 133. 1942.

CONSERVING NAMES OF FUNGI

C. L. SHEAR

Having just had an opportunity to peruse Dr. Donk's article (**4**) on the conservation of generic names, I am moved to make a few remarks on what may be considered an already threadbare subject. However, as long as a few curious people, even in time of war, persist in pursuing and naming the lowly fungi and cannot seem to agree on any simple and rational method of choosing their names, perhaps further discussion may be justified.

In recent years considerable progress has been made by international botanists toward the stabilization of generic and specific names. The type method of fixing such names has been generally adopted and also the conservation of our common and well known generic names. The conservation of specific names seems equally desirable. It is being urged by some of our English colleagues and we hope it may be provided for in the next revision of the code.

It has taken much time and effort to get these principles accepted. Our chief problem now is to find some more practical plan for selecting and typifying generic names. Many of us have apparently become so attached to the priority plan that it is difficult to give it up even in special cases. Before it was agreed to make exceptions to the almost sacred law of priority we could not agree on a starting point, and so long as we make priority the major principle in the choice of names, and in addition fix various dates for the starting points of various groups of fungi, we cannot hope to reach any great degree of uniformity or stability in the choice and application of names, even after a great amount of bibliographic and herbarium work under the most favorable library and herbarium facilities, has been carried out. That priority with its multiple starting points is the cause of much confusion and waste of time and effort in reaching any satisfactory conclusion by the present plan is most forcibly and convincingly illustrated by Dr. Donk's discussion of *Corticium* (**4**, p. 164–7) as well as other generic names. Persoon (**9**), who first used the

name in 1794, had a rather definite idea of the group, in which he included six species. Three of these species have since been transferred to *Peniophora* Cooke (**3**), and one to *Aleurodiscus*. The other two, *C. roseum* and *C. laeve*, have been treated as good species of *Corticium* by nearly all mycologists down to the present time. Very little was added in the way of more exact definition of the genus until about 1890, when the advent of more careful and thorough microscopic studies added much to our knowledge of the morphology of the fungi and provided the basis for a more definite and natural conception of the genus.

The group of fungi under consideration, whether you call it a genus or put it in some other category, has been evolving through millions of years to reach its present condition and character. The taxonomic concept of mycologists has been evolving for about one and a half centuries. Persoon's concept and the species he included was much more in accord with recent concepts, (for example, Burt's (**1**)), than the vague and confused application of the name by Fries, which reached its climax in his latest treatment (**8**), where he included seventy-five species, representing a half dozen or more different genera, according to recent authors. This case might be cited as an example of the evolution of a generic concept in reverse. Donk in an earnest effort to follow the rules which require all genera of Hymenomycetes to start with Fries, after much labor and doubt as to where and when Fries validly published the genus according to the provisions of the present code, decides on Floram Scanicam 1835 (**5**), but as no species were mentioned there he must go on to Genera Hymenomycetum, 1836 (**6**) where a few species are listed. But in order to get a type species which would fix the name as it is commonly applied at present, he has to go still farther, to the Epicrisis, 1838 (**7**). Thus we have all this labor and maneuvering in order to attribute the name to Fries and still recognize Persoon by the clumsy formula "Pers. ex Fries." It is difficult to see what useful purpose has been served by all this expenditure of time and labor.

The opponents of conservation claim that it is impractical. If all this trouble is necessary their claim is justified. When or by whom many of the older genera were really established in their present usage and concept can scarcely be determined with cer-

tainty. This condition of affairs is strikingly illustrated by most of the cases which Donk discusses and should be sufficient to convince any fair-minded mycologist of the futility of trying to save our present names by appealing to priority, especially when based upon various starting points which do not cover some of our well known names coming from earlier authors. The name *Corticium* is Persoon's, the concept and the species it includes are the result of various changes made by various authors which are not covered by "Persoon ex Fries" but more completely by *Corticium* Auct. Misc. If one is interested in the evolutionary vagaries of the mycological mind and the detailed history of the use and abuse of some of our common generic and specific names of fungi, such studies as these of Dr. Donk may be justified, but to require them as a preliminary to the typification and conservation of a common and well known name like *Corticium* is a great waste of time and a reflection on the mental capacity of mycologists.

Now let us approach the problem from another angle. Dr. Donk and many other mycologists agree that it is important to conserve as far as is practicable the present names of our well known and widely distributed genera. Why not admit that Persoon, who was the first to use the name *Corticium* and whose definition and application was much more consistent and more nearly in accord with present usage than that of Fries, was the first to name the genus?

Why worry so much about who shall be given credit or discredit for having proposed a generic name, as in most cases of the older genera no single author really defined the genus according to its present concept and its final definition, if ever agreed upon, will probably involve the work of yet unborn mycologists.

Instead of so much stress on dates and priority, a much simpler and more rational plan of attaining the desired result in conserving generic names would be to first determine what names should be conserved and what species should be selected as their types, in order to bring most of the species now generally included under a particular name together.

Take *Corticium* for example. Let us forget for the moment, priority and authority. It is proposed to hold this name against all other names whatever their claims may be. Next, what group

of species is at present included under this name by most authors and which of these species is well known and fairly typical of the group? If the present group of species still includes any of those listed by the original author of the name, in this case Persoon, the one most typical of the present group should be chosen. According to this plan, *C. roseum* Persoon was chosen by Clements and Shear in *The Genera of Fungi* (**2**), as up to the present time most authors have regarded it as a good *Corticium*, but now Dr. Donk concludes (**4**, p. 166) that this species represents a genus distinct from the bulk of the present species of *Corticium* and therefore another type must be chosen. Very well, there is still another good species of Persoon in the present genus—*C. laeve*. Why not take it and settle the case at least until someone proposes to found a new genus on that species? Our only hope, apparently, for more than temporary stability, depends upon how far the present tendency of the so-called splitters to multiply new genera will go. Let us hope that our genera will not eventually all become monotypic.

Instead of the simple procedure we have just proposed, we must, according to the rules, bring Fries into the case in order to validate and establish the name. Dr. Donk after a rather brave and lengthy struggle selects *C. confluens* Fries as the type of the genus to be held until some way can be found to validate Persoon's name according to the rules. Thus after all this labor we still have perhaps only a temporary type for the genus. If further examples of the impracticability of the present plan are necessary in order to convince one of the great need of a revision of the rules and the elimination of the Friesian starting point, they are amply provided in the other cases treated by Dr. Donk in the paper cited.

With all our vaunted pride in liberty and freedom we still find it difficult to free ourselves from the habit of bowing obsequiously to so-called authority. Credit to whom credit is due, but blind following of authority when it impedes the advancement of science can scarcely be justified. We are glad to recognize Fries as a great and good mycologist, but why make an idol of him and declare that no name published before him shall be used without his sanction, and the wasting of time, space and paper by such

clumsy citations as "Persoon ex Fries"? This carries the assumption that Fries had the same thing as Persoon and that this has been verified by comparison of Persoon's and Fries' specimens. There appears to be no good reason, therefore, why he should be given credit for or held responsible for all the names of earlier authors which he happened to adopt. We once contended (**10**) and still believe that if we must have a nominal fixed date as a starting point for generic nomenclature Tournefort would be the most just and logical. Tournefort, Micheli, Battarra, Schaeffer, Bulliard, Persoon and other pre-Friesian authors have given us generic and specific names which are still current and should be recognized whether they happen to have been adopted or approved by Fries or not. If we have a single starting point for both genera and species, Linnaeus is the least objectionable. The major effort should be to conserve names by a simple method of selecting types which will fix them in accord with the best present usage whether they were first proposed by Tournefort, Micheli, Persoon or some other author.

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LITERATURE CITED

1. **Burt, E. A.** The Thelephoraceae of North America. XV. *Corticium*. Ann. Mo. Bot. Garden **13**: 173–354. 1926.
2. **Clements, F. E. & Shear, C. L.** The Genera of Fungi. 496 pp. 1931.
3. **Cooke, M. C.** On *Peniophora*. Grevillea **8**: 17–21. 1879.
4. **Donk, M. A.** Nomina generica conservanda and confusa for Basidiomycetes (fungi). Bull. Bot. Garden Buitenzorg III. **17**: 155–197. 1941.
5. **Fries, E. M.** Corpus florarum provincialium Sueciae. I. Floram Scanicam scripsit. 394 pp. 1835.
6. ——. Genera Hymenomycetum quorum novam expositionem. 17 pp. 1836.
7. ——. Epicrisis systematis mycologici. 608 pp. 1836–38.
8. ——. Hymenomycetes Europaei sive Epicriseos systematis mycologici. 756 pp. 1874.
9. **Persoon, C. H.** Neuer Versuch einer systematischen Eintheilung der Schwämme. Römer's Neues Mag. f.d. Bot. **1**: 63–128. 1794.
10. **Shear, C. L.** Generic nomenclature. Bot. Gaz. **33**: 220–229. 1902.

GOUIRAND AND BERGERON'S TREATMENT OF SPHACELOMA AMPELINUM

ANNA E. JENKINS AND A. A. BITANCOURT

(WITH 1 FIGURE)

Arnaud and Arnaud (**2**), in 1931, and Puttemans (**12**), a few years later, alluded to the revival of the old form genus *Sphaceloma* DeBary (**4**). A revised description of this genus, which is typified by *S. ampelinum* DeBary (**4**), has been published recently (**10**). At the same time the description of the ascomycetous genus *Elsinoë*, technically typified by *E. Canavaliae* Rac.[1], was emended with mention of *Sphaceloma* as the conidial stage. *S. ampelinum*, now classified as *E. ampelina* (DeBary) Shear (**14**), is, of course, best known as the cause of grape anthracnose; as such, it is widely illustrated in literature dealing with diseases of the vine.

Generally unfamiliar to mycologists is the graphic account of *Sphaceloma ampelinum* published in 1897 by Gouirand and Bergeron (**6**, *figs. 1–7*). Their interesting line cuts are not cited in Saccardo's *Index Iconum Fungorum* (**13**), in which the organism appears under the binomial *Gloeosporium ampelophagum* (Pass.) Sacc. To increase the availability of the illustrations just cited, which make clearer an understanding of certain aspects of the life history of the organism, particularly with respect to conidial formation, they have been photographed and assembled on the accompanying Plate (FIG. 1, A–G), with the original legends given in full. A recent article by du Plessis (**11**) illustrates similar conidial development.

Gouirand and Bergeron were concerned primarily with the action of certain fungicides on the grape pathogene in a resting condition. They refer to Viala and Ravaz (**17**) as having stated that the fungus passes the winter in concentrated mycelial masses in the cankers, which in spring give rise to conidia. These growths are termed "sclerotia" by Gouirand and Bergeron.

[1] This species is illustrated by Arnaud (**1**, *pl. 3, A–D.*).

They describe (**6**, p. 5–6 and Figs. 1 and 2) a stem canker in autumn, both in its general appearance and in section. They also depict (**6**, p. 6–7 and Figs. 3 to 5) the sclerotia in different stages of development and the manner of conidial formation from them in the spring. In the laboratory this process was conveniently followed by placing thin sections of dormant sclerotia in drops of water suspended on a cover slip inverted over a culture cell (**6**, p. 7–8 and Figs. 6 and 7).

Jaczewski (**7**),[2] who cites Gouirand and Bergeron, states that the sclerotia of *Sphaceloma ampelinum* become evident at the close of summer. He explains that they correspond to the conidial layers that have reached a period of rest, therefore, do not form conidia. He adds that he has observed this transformation under natural conditions, and continues: "In the spring the hymenial layer of conidiophores is again produced." According to him these sclerotial formations are retained in the old wounds for several years, forming annually a new hymenial layer of conidiophores on their surfaces. Illustrations of sclerotial masses are shown by Viala and Pacottet (**15**, **16**) who credit Goethe (**5**) with having first observed them. The old conidial layer is apparent on the mature sclerotial development illustrated by Gouirand and Bergeron (**6**, *fig. 5*). This structure, acting as a sclerotium, corresponds closely to the conidial stage of *Elsinoë australis* Bitancourt and Jenkins as illustrated elsewhere (**3**, *pl. 25, C–F*).

Doubt was expressed by Gouirand and Bergeron, as well as by others, as to whether more than one spore can be produced from a conidiophore of *Sphaceloma ampelinum*. There is probably little question that the several detached conidia shown in their figure 7, *e*, were reproduced successively from the conidiophore there shown. Similar conidial formation is illustrated for *Elsinoë Fawcettii* Bitancourt and Jenkins both in culture (**9**, *fig. 7*) and in nature (**8**, *fig. 4, G*). DeBary (**4**), who described the formation of young conidial fructifications of *S. ampelinum*, mentioning the short pointed hyphae (conidiophores), stated that conidia were produced abundantly when young lesions were brought in contact with water. A conidial fructification from nature showing num-

[2] Acknowledgment is made to the Division of Silvics, U. S. Forest Service, for a translation of this article.

erous conidia, illustrated by Briosi and Cavara, is here reproduced (FIG. 1, H).

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LITERATURE CITED

1. **Arnaud, G.** Les Astérinées, IV^e^ partie. (Études sur la systématique des champignons pyrenomycetes). Ann. Sci. Nat. X. **7**: 643–722. 1925.
2. **Arnaud, G. & Arnaud, M.** Traité de pathologie végétale I. 2 1505. 1931.
3. **Bitancourt, A. A. & Jenkins, A. E.** Ciclo evolutivo de *Elsinoë australis* Bitancourt e Jenkins, agente da verrugose da laranja doce. Arq. Inst. Biol. (São Paulo) **10**: 129–146. 1939.
4. **Bary, A. de.** Ueber den sogenannten Brenner (Pech) der Reben. Ann. Oenol. **4**: 165–167. 1874.
5. **Goethe, M. R.** Mittheilungen über den Schwarzen Brenner und den Grind der Reben. 38 p. Berlin and Leipzig. 1878.
6. **Gouirand, G. & Bergeron, G.** Observations sur le traitement de l'anthracnose. Rev. Vit. **7**: 5–10. 1897.
7. **Jaczewski, A. A.** Antraknoz i khloroz. (Anthracnose and Chlorosis.) Trudy Biuro Mykol. i Fitopat. 9, 67 p. 1911.
8. **Jenkins, A. E.** Development of the citrus-scab organism *Sphaceloma fawcettii*. Jour. Agr. Res. **42**: 545–558. 1931.
9. ——. Comparações culturaes e inoculações em videira com os fungos *Elsinoë fawcettii*, *E. ampelina*, e *E. veneta*. Arq. Inst. Biol. **7**: 23–32. 1936.
10. —— **& Bitancourt, A. A.** Revised descriptions of the genera *Elsinoë* and *Sphaceloma*. Mycologia **33**: 338–340. 1941.

FIG. 1, *A–G*. *Sphaceloma ampelinum* DeBary. (After Gouirand and Bergeron (**6**)). The letters *A–G* correspond to their figures 1 to 7, of which the legends are quoted below: *A* (1). "Aspect d'une lésion d'anthracnose pendant l'hiver: *scl*, sclérote formant une bordure noire autour du chancre." *B* (2). "Coupe à travers un chancre d'anthracnose ayant détruit l'écorce et une portion du bois; *b*, bois; *rm*, rayons médullaires; *fp*, faisceaux de fibres péricycliques; *c*, cuticule; *l*, lames de liège tendant a preserver les tissus sousjacents; *scl*, sclérotes à differents états de développement, très développés à droite, plus jeunes à gauche; *m*, filaments mycéliens isolés." *C* (3). Sclérote à son premier état de développement: *scl*, cellules de sclérote; *e*, épiderme; *c*, cuticule." *D* (4). "Sclérote plus avancé ayant déchiré la cuticule *c*, et pénétré dans les cellules de l'épiderme, *e*." *E* (5). "Sclérote complètement formé: les cellules sont très brunes a l'extérieur, d'une teinte moins foncée a l'intérieur; au bas, on voit le mycélium non condensé." *F* (6). "Sclérote dont quelques cellules commencent à émettre un prolongement, *b*." *G* (7). "Formation des spores sur les filaments nés du sclérote: *a*, *b*, *c*, *d*, *e*, états successifs."

H. *Sphaceloma ampelina*, after Briosi and Cavara, I funghi parasiti delle piante coltivate od utili. Fasc. 4, no. 96, fig. 3. 1889.

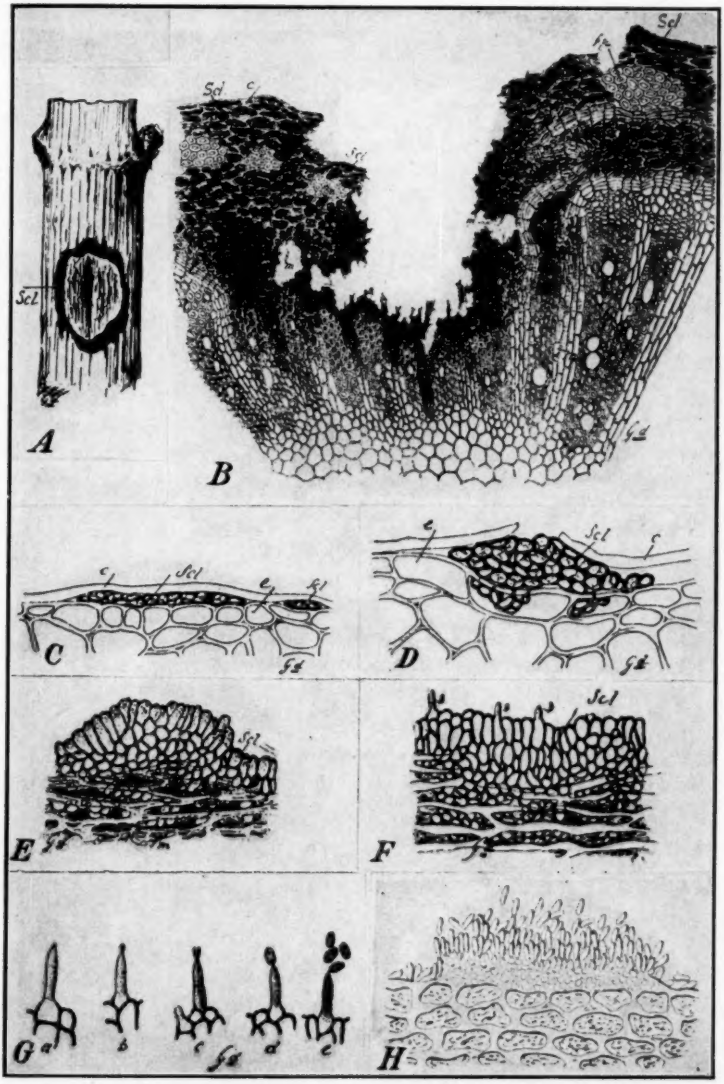

FIG. 1.

11. **Plessis, du, S. J.** Anthracnose of vines and its control in South Africa. Dept. Agr. and Forestry (Stellenbosh Series No. 40) Union of South Africa. Sci. Bull. 216, 47 p. 1940.
12. **Puttemans, A.** Ligeira contribuição a phytopathologia brasileira. O Campo 5: 20–25. 1934.
13. **Saccardo, P. A.** Index Iconum Fungorum. Sylloge Fungorum 19: 768–769. 1910.
14. **Shear, C. L.** The life history of *Sphaceloma ampelinum* de Bary. Phytopathology 19: 673–679. 1929.
15. **Viala, P. & Pacottet, P.** Nouvelles recherches sur l'anthracnose. Rev. Vit. 24: 657–663. 1905.
16. ——. Recherches sur l'anthracnose. Rev. Vit. 25: 89–91. 1906.
17. **Viala, P. & Ravaz, L.** Recherches expérimentales sur les maladies de la vigne. Compt. Rend. 106: 1711–1712. Jan.–June 1888.

SOME BASIDIOMYCETES FROM MOUNT SHASTA

Wm. Bridge Cooke

During my residence of three summer months of each of six years at timberline on Mt. Shasta, a Cascade Range peak located in southern Siskiyou County, California, I have found several common, unusual, rare, or hitherto unknown Basidiomycetes. Of these, several are worthy of notice from the point of view of habitat, frequency of occurrence, interesting structure, or novelty.

In the vicinity of the Shasta Alpine Lodge the forest includes almost exclusively the Shasta Red Fir, *Abies magnifica* var. *shastensis* (**5**). The Lodge is at the upper limits of the Canadian Zone and the lower limits of the Hudsonian Zone (**9**). The former zone on the southwest side of the mountain consists in the main of Shasta Fir, and the latter zone consists in the main of White Bark Pine, *Pinus albicaulis*. Because of edaphic conditions the mycobiota of the Shasta Fir forest is much richer than that of the White Bark Pine forest (**6**). This is also true of the sub-shrub layer composed of *Arctostaphylos nevadensis*. The area has been untouched by fire and only since 1922 has the axe entered it, and this sparingly in the use of young trees for timbers and in the use of dead trees for firewood. The logs which have been studied have all fallen from natural causes; avalanche, windstorm, heart rot and root and butt rot being the commonest of these.

As the snow line recedes up the mountain from an average of 3000 feet to above timberline the logs become exposed to the desert-like atmosphere of the drying winds. Apparently under the cover of the snow fungus activity can be carried on. As soon as the drying winds start this activity appears to cease. However, within the larger logs the rotting activities of numerous micro-organisms can be carried on, for it takes a long time for these logs to dry out. In any event the time taken for the complete decay of logs is long, for fallen timber in at least one ava-

lanche area is still in a fair state of preservation, although not all of each log is usable for fire wood, more than twenty years after the avalanche flattened the forest as if it were a handful of match sticks. In contrast to this condition is the condition of trees which have fallen as a result of the weakening effect of heart rots, such as *Fomes officinalis*, *Fomes pinicola*, *Fomes subroseus*, *Porodaedalea Pini*, and others, and of butt and root rots such as *Armillaria ?mellea*. These trees fall during high winds with most terrifying sound. They quickly disintegrate both as a result of continued saprobic activity on the part of the primary cause of their downfall and as a result of numerous secondary and possibly even tertiary rots. It is to these groups of fungi that our attention is drawn. They are usually found by removing the layer of bark on the fallen trunk which protects the sapwood and heartwood from drying out in the hot dry summer winds. When this layer of bark is absent the sapwood forms a protecting layer around the moist heartwood. These fungi are not always found in only this habitat, since some also occur on pieces of structural wood or fire wood in use around the Lodge outbuildings from the stable to the kitchen.

HETEROBASIDIOMYCETES

TREMELLACEAE

1. TREMELLODON GELATINOSUM (Scop. ex Fries) Pers. ex Fries.

During the summer of 1939 several collections of this fungus were made. It was found inside of and in cracks between cubical rot chunks of prostrate Shasta Fir logs well protected from the dry air. The fructifications were much smaller than those found commonly in the moist coastal forests of California and Oregon. Collections in the Herbarium at the University of California indicate that this is an unusual habitat, at least in California, for this species.

DACRYMYCETACEAE

2. GUEPINIOPSIS ALPINUS (Tracy & Earle) Brasfield.

This is the commonest Basidiomycete on Mt. Shasta. It occurs on dead sticks and rotting logs throughout the Shasta Fir

forest as well as on debris of *Tsuga Mertensiana* and *Pinus albicaulis* (and possibly on other hosts). It is common on posts, timbers and hand-hewn boards on the wood buildings around Horse Camp.

HOMOBASIDIOMYCETES

THELEPHORACEAE

3. SOLENIA CANDIDA Pers.

This interesting species is found occasionally on the underside or on the inside of rotting logs in the vicinity of timberline near Horse Camp. It has been seen so far only on Shasta Fir. A colony may be as large as a yard long and several inches wide.

4. ALEURODISCUS DIFFISSUS (Sacc.) Burt.

Peniophora diffissa Sacc.
Aleurodiscus succineus Bres.
Aleurodiscus sajanensis (Murashk. in Litt.) Pilát.

Fructifications appearing at first sight of two types: a type which grows as a *Peniophora* in a continuous patch on the underside of twigs and apparently completely resupinate; and a type which appears at first glance like thin fructifications of *Stereum frustulatum*. However, on closer inspection it is seen that the first type is merely a manifestation of the luxuriant growth of the second type. In certain conditions the separate fructifications of the species, as indicated by their points of attachment seen in older, curled-up examples, may join at the edges and form sheets; again, under certain conditions the individual fructifications may continue to grow close together for several seasons, as indicated by the several layers of hymenia on top of each other, without fusing, thus appearing in close-growing instances to have broken apart (the basis of the specific name).

Hymenial cells large, 54 × 9 μ, staining deeply with phloxine, no fertile basidial cells seen although many of the cells seen may have been basidial initials; later these cells, or cells like them as well as narrow cells one-third as wide, bear one of more acanthophyses which are 9–27 × 7–8 μ with appendages in whorls or

spirals of 4–5 rows around a central axis 1.8–4.5 μ wide, appendages 2–4 × 0.9–1.35 μ; pseudophyses occur in older specimens, rarely in young material, mostly found in collections made on *Arctostaphylos patula*, rare in collections from a higher elevation on *A. nevadensis*, 60–70 × 9 μ; no spores seen in several mounts from several collections. As many as 10 layers of zones carrying acanthophyses occur in older specimens; 1–2 layers are common in all collections. Acanthophyses are easily separable from what apparently are mother cells which may have one to many additional appendages but in scattered order; axes of separable portions of acanthophyses variable in thickness, some appearing ellipsoid to tubular, others lance-like; some of the staining cells appear to cut off by septation one to several of these acanthophyses which cover the hymenium, giving it a silky sheen in certain light; these separable structures remain uncolored by phloxine and in their normal position on the hymenium, where they appear to form a sort of epithecium, are penetrated only by the pseudophyses. A subhymenial structure of simple type was observed throughout all mounts.

The species is common on dead sticks of *Arctostaphylos nevadensis* found *in situ* in patches of the host which form large carpets in forests of Shasta Fir and on the borders of these forests throughout the southwestern slopes of Mt. Shasta, particularly near economic timberline. It also occurs on dead sticks of *Arctostaphylos patula* on the ground in the upper humid Transition zone.

It is interesting to note that the species has hitherto been known only from rather fragmentary collections. These collections, as well as those mentioned above, have been made only from hosts belonging to the Ericaceae. Bresadola's *A. succineus* was collected by Weir in Oregon from *Arbutus Menziesii*. Bresadola (**2**) found no mature spores in this material. The other host on which this species has been reported is *Rhododendron dahuricum*. In the writings of Saccardo, Murashinsky, Burt (**3**), and Pilát this species has been described from two collections from Manchuria and Siberia. D. P. Rogers, as well as the writer, could find no spores in the Shasta material. However, he reports, in a letter to the writer, that the spores of Murashinsky's collection are cylindric, even, strongly amyloid, and measure 17–18 × 5.5–6.5 μ.

5. ALEURODISCUS AMORPHUS (Pers.) Rab.
Aleurodiscus Grantii Lloyd.

Fructification small, rarely more than 2 mm. in diameter, sometimes two or more confluent and then up to 5 mm. across; pink in color, with white margin and underside, hairy, when dry extremely patellate, appearing like a small *Dasyscypha*. D. P. Rogers, who examined the material collected by the writer from both *Abies concolor* and *Abies magnifica* var. *shastensis*, reported that the roughenings on the walls of the spores could be brought out only with iodine in the material collected on *A. concolor*, while that collected from the other host showed markings in KOH; Dr. Rogers also reported that the pseudophyses, usually abundant in relatively sterile specimens, were entirely lacking in my extremely fertile material.

It was of interest to compare my material macroscopically with other California collections on file at the University of California and determined by H. S. Jackson. This material was collected by Parks in the Trinidad area of the California coast. In size it was much larger, confluent patches attaining a width of over 1 cm. and single fructifications being rarely less than 2 mm. across. Material from *Pinus muricata* was mostly yellow in color while that from *Abies grandis* had narrower white margins and was more buff in color with only a slight trace of pink.

6. **Aleurodiscus fruticetorum** W. B. Cooke, sp. nov.

Appearing like a *Stereum* in habit and in cross section; margin reflexed up to 0.5–1 cm., white to gray, hirsute above; with an orange, waxy hymenium, orange-yellow when dry, covering a white tissue; hymenium composed of basidia, cystidia and acanthophyses; cystidia are deeply staining structures (in KOH and phloxine), obtuse-clavate, 80–117 × 7.2–10.8 μ, which extend 18–25 μ beyond the hymenium and are densely guttulate; acanthophyses scattered through the hymenium are easily confused with the basidia because of their identical size, of several sorts (possibly stages in development): those with a few appendages at the extreme tip of the cell, those with the appendages scattered to crowded over the top 5–10 μ of the cell, and those with the appendages scattered over the upper quarter and the upper and middle quarters of the cells; basidia 60–70 × 7–9 μ, with sterigmata 7–7.5 × 2–2.5 μ; spores evenly ellipsoid-cylindric, smooth-walled, hyaline, not amyloid, abundant, 10.8–12.6 × 5.4–7.2 μ.

Stereo habitu et sectione transversa simulans, margine usque ad 0.5–1 cm. reflexo, albo vel griseo, super hirsuto, trama alba, hymenio ceraceo, colore aurantio vel siccato demum flavo-aurantio, cum basidiis, cystidiis acanthophysibusque, cystidiis obtuso-clavatis 80–117 × 7.2–10.8 μ, supra hymenium 18–25 μ longe exsertis et dense guttulatis; acanthophysibus per hymenium sparsis, basidiis multo similibus propter formam, basidiis 60–70 × 7–9 μ, sterigmatibus 7–7.5 × 2–2.5 μ; sporis ellipsoideo-cylindraceis, laevibus, hyalinis, non amyloideis, numerosis, 10.8–12.6 × 5.4–7.2 μ.

Collected on *Arctostaphylos patula* and *Ceanothus velutinus* twigs and sticks in a patch of chaparral at 6000 feet on Mt. Shasta near Wagon Camp, Aug. 18, 1941, *WBC 15731*—Type; and *15732*.

The specific name was chosen because of its association with both dominants of the secondary Shasta chaparral. It was included in this genus on the recommendation of D. P. Rogers. The basidia and spores are too large for *Stereum*, and the described cystidia which originate as gloeocystidia are not found in *Stereum* species. The hyphae, while forming a waxy hymenial area, do not gelatinize and so keep the species out of *Cytidia*. Although there is no mineral matter in this species it is therefore included in *Aleurodiscus*.

7. PELLICULARIA FLAVESCENS (Bon.) Rogers.
Botryobasidium ochraceum (Mass.) Donk.

Among a collection of molds sent to Dr. Linder for identification this species had crept. It grows on rotten wood on the inside of Shasta Fir logs. It has been collected here but once.

8. STEREUM RUGISPORUM (Ellis & Ev.) Burt.
Hymenochaete rugisporum Ellis & Ev.

While *Hymenochaete* is characterized by usually spindle-shaped setae on hyphae originating at various points throughout the subhymenial region and protruding beyond the hymenium, as well as by the presence of a chemical (referred to as thelephoric acid) which turns black and makes the specimen opaque in KOH mounts, this combination of characters is replaced in this species by another combination which, it is suggested, may be related to those of the primitive *Hymenochaete* type. In *Stereum rugisporum* the spindle-shaped setae are replaced by dark brown hypha-like

structures which originate at different levels throughout the thick subhymenial region as one of two or three series of hyphae which compose the fructification. These brown hyphae extend beyond the hymenium up to 45–72 μ in our specimens although Burt reported them up to 110 μ. They have a thick wall until near the tip, which has a blunt point, thin wall, and, in phloxine, red-staining contents. These cystidium-like structures are not as common in occurrence in the hymenium of material collected on Mt. Shasta on burned Shasta Fir as they are in specimens collected by Bonar on *Abies magnifica* at Gold Lake in Plumas Co. in 1942. There are at least two series of hyphae in the fructification, one dark brown series giving rise to the cystidia, the other light brown and apparently giving rise to the ultimately hyaline hymenium. There appear to be at least two layers of hymenial areas in sections of the Mt. Shasta material, indicating that at least two seasons of growth were required The margins are obtuse and the fructifications thick, as thick as 2 mm. in the Gold Lake material. On Mt. Shasta the specimens collected have been found only on burned dead logs (burning having been caused by lightning or camp fires).

9. HYMENOCHAETE TABACINA ([Sow.] ex Fries) Lév.

This common thelephore was found on a shrub of *Ceanothus velutinus*. This shrub is one of the important members of the chaparral which invades burned-over areas on the mountain. As the normal forest cover returns to these chaparral areas it smothers the shrubs. This shrub had been smothered by a grove of young trees of *Abies concolor*. Every prostrate branch of the shrub had sporophores of the fungus, the only time the fungus has been noted on the mountain.

HYDNACEAE

10. CALODON AMICUS Quélet.

A large colony of sporophores of this tough "mushroom" was found along the Sisson Southern Trail under a patch of *Arctostaphylos nevadensis* on Shasta Fir duff in the Shasta Fir forest. It has been included in the writer's exsiccati under the number 56.

11. ECHINODONTIUM TINCTORIUM Ellis & Ev.

Along the Sisson Southern Trail a mixed colony of *Abies concolor* and Shasta Fir has been infected by this species. It occurs at other points on the mountain but its effects on the forest are most conspicuous here.

MERULIACEAE

12. **Serpula americana** (Burt) W. B. Cooke, comb. nov.

Merulius americanus Burt.

Fructifications forming large patches up to 10 × 100 cm.; hymenium gyrose-porose, pores up to 5 mm. across and from 0.5–5 mm. or more deep, when deep labyrinthiform, when shallow netlike, more or less irregular; hymenium honey-brown, with a white subiculum which is layered and easily separable from the substratum in large sheets; spores (4.5) 5–6 × 10–11.5 (12.5) μ, light brown in a KOH-phloxine mount, egg-shaped but flattened on one side; when fresh the fructification is more or less fleshy at least in the areas close to the hymenium and heavily infested by a beetle which devours the collection unless carefully fumigated when collected; hyphal layer next to the substratum with hyaline and brown hyphae parallel to the substratum, internal layer appearing to have been partially gelatinized, loosely arranged, parallel to the substratum but without brown hyphae, near the hymenium forming a denser layer perpendicular to the substratum; brown hyphae 5–6 μ in diameter, hyaline hyphae 3–4 μ in diameter, neither set encrusted but both sets with clamps; spores in several stages of growth on the sterigmata hyaline; sterigmata 7.2 μ, basidia 36 × 7.3 μ.

This species is common on Mt. Shasta and has been collected at a number of stations near economic timberline on fallen logs of Shasta Fir. It has been observed in each of six summers in which collections have been made although it is distinctly annual. Our material differs from that observed by Burt in several points. Burt described his species as being papery rather than fleshy and this may indicate that he did not know the species in the field. However, it is thought that the differences between the two sets of material are not sufficient to warrant the erection of a new species on my collection which has been included in my exsiccati as number 46.

In the writer's report on the generic nomenclature of pore fungi (**8**) the Meruliaceae were not considered except by citation. Since Rogers (**13**) has shown that S. F. Gray's genera are post-Friesian, and since the writer believes that *Merulius* as understood today can be better understood as two genera on the basis of the hyaline (*Merulius*) and colored (*Serpula*) spores, the above disposition of this species is considered valid.

This species has been found twice in California in addition to the Mt. Shasta record as indicated by collections at the University of California. Mrs. M. R. Gibbons found a small specimen at Badger Flat above Huntington Lake in Fresno Co. on *Pinus contorta* var. *Murrayana*, June 20, 1941. A second collection, complete with large rhizomorphs, was made from wood on the floor of a private garage in Berkeley on Jan. 26, 1934—this was determined by C. J. Humphrey.

13. MERULIUS BELLUS Berk. & Curt.

Several collections of this interesting fungus have been made in the vicinity of Horse Camp on Shasta Fir logs. In microscopic characters this material differs from that described by Burt in that clamp connections are common and the fructification is not at all easily separable from the substratum. The presence of encrusted hyphae and the spore shape and size as well as other characters appear to be quite typical, however. Collection number *WBC 8564* made on July 7, 1937, has been included in the writer's exsiccati under the number *47*. This material agrees in characters with material collected from an old conifer log on Isle Royale, Michigan, determined by A. H. Povah, and a duplicate of which is deposited in the University of California herbarium. The Mt. Shasta collections are the only ones from California in that herbarium. In a letter from Dr. L. O. Overholts attention is called to the discrepancies between my material and Burt's description although Dr. Overholts concurred at that time in my use of this name.

14. MERULIUS CERACELLUS Berk. & Curt.

Material referred to this species was collected on an old Shasta Fir log near Horse Camp, at 8500 feet, on July 28, 1938 as *WBC*

10253 and included in the writer's exsiccati as No. *48*. While this species is reported as exclusively frondicolous by Burt, my material answers Burt's description except for the heavily encrusted hyphae. No California material other than this has been referred to this species in the University of California herbarium. Although in neither this nor the above species does the avellaneous subhymenial zone described for these species by Burt, and present in collections in Dr. Overholts's herbarium, occur, Dr. Overholts felt, according to his letter of June 28, 1940, that I was justified in the use of this name for my material.

15. **Merulius atropurpureus** W. B. Cooke, sp. nov.

Older portions of fructification show shallow pores or mere reticulations on a smooth hymenium which is red-pink near the white cottony fimbriate margin to deep blood red in older portions in dry material, salmon to magenta pink when fresh; hymenium becoming black-purple in KOH; subicular hyphae heavily encrusted, 6.3–7.2 μ in diameter, without clamp connections; basidia 18 × 3.6 μ, spores 4.5 × 1.5 μ; long, brown, encrusted cystidia occasional, extending up to 20 μ beyond the hymenium, 35–40 × 4–5 μ. Fructification resupinate, strongly adnate to the substratum, forming large patches up to 2–4 × 5–8 cm.

Resupinatus, adnatus, hymenio primum laevi demum reticulato, margine albo-fimbriato, hymenio in sicco colore obscure sanguineo vel in KOH atropurpureo, tramae hyphis dense incrustatis, non nodososeptatis, 6.3–7.2 μ latis, basidiis 18 × 3.6 μ, sporis 4.5 × 1.5 μ, cystidiis raris, longis, brunneis, incrustatis, 35–40 × 4–5 μ, ex hymenio 20 μ emergentibus.

On Shasta Fir near the Sisson Southern Trail at about 7000 ft., June 17, 1938, *WBC 10117*. Collected only once and then in dense forest.

The specific name was selected because of the striking color of the hymenium in KOH.

16. PHLEBIA MERISMOIDES Fries.
Phlebia radiata Fries.

Fructification strongly adnate, forming large sheets over the substratum; white to pale cream color when fresh, tan to resinous brown when dry with resinous, more or less fimbriate but not definitely hyphal margin; ridges radiating regularly and branching

regularly from centers, with tooth-like projections along the ridges; hymenium composed entirely of 4-spored basidia which bear numerous spores 5.4–6.3 × 1.8–2.7 μ, hyaline, ovate, not allantoid.

WBC 15624, collected on a fallen log of Shasta Fir in woods above Panther Creek meadows at about 8000 feet, July 28, 1941. Issued in exsiccati as No. *128*.

A collection made by Lee Bonar on *Abies magnifica* at Gold Lake, Plumas Co., July 29, 1942, appeared exactly as the above description in the older material. The younger specimens he obtained were sterile but gelatinous, shiny, pale cream to tan, with a hyaline margin which appears to have been gelatinized, is rarely resinous, and is not fimbriate.

POLYPORACEAE

17. AURANTIOPORELLUS ALBOLUTEUS (Ellis & Ev.) Murrill.
Fomes alboluteus Ellis & Ev.
Polyporus alboluteus Ellis & Ev.

The most conspicuous pore fungus on Mt. Shasta as the snow is melting away from rotting logs in the forest is this species. It forms large orange sheets on the under side of rotting logs which still retain their original shape. The fungus is quickly eaten by the beetle *Dacne picea* Lév. and needs quick fumigation, even while drying, to prevent loss of the specimen. The fungus is nearly resupinate although in most cases a comparatively large mass of material which looks like a sponge, and is usually more than 1 cm. thick and 1–2 cm. or more high above the level of the highest tubes, is present. Late in the summer logs on which this fungus has fruited can be distinguished by the piles of reddish fungus remains deposited on the ground by the above mentioned insect.

18. COLTRICIA PERENNIS Fries ex. S. F. Gray.
Polyporus perennis Fries.
Polystictus perennis Fries.
Coltricia connata S. F. Gray.

At a number of stations in several types of habitat this species has been collected at least once a year on Mt. Shasta. It has been

found on rich humus in moist soil at Panther Creek heather meadows, on Shasta Fir duff near springs in the vicinity of Bear Springs, on sandy lava soil in fir forests and in the bed of an intermittent stream in Cascade Gulch. Its elevational range varies from 5000 to 8000 feet in the collections so far made.

19. **Cristella candidissima** (Schw.) Donk in mss. ex W. B. Cooke com. n.
Polyporus candidissimus Schw.
Poria candidissima (Schw.) M. C. Cooke.

Of the several species of *Poria* collected on Mt. Shasta this is the most interesting. Its hyaline, asperulate, ovate spores, ampullae, abundant clamp connections and fasciculate basidia set it apart from the others. It also has encrusted hyphae. In the Mt. Shasta material, collected from rotten Shasta Fir logs, several forms of fructification are found. In the simplest, the pores are hardly more than shallow pits, while in the more complex the pores are long, irpiciform tubes, somewhat more floccose but with the same appearance as those of larger specimens of *Polyporus versiporus* (*Poria mucida*) which has not yet been found on the mountain. The affinities of this species, rather than with other species of *Poria* which are really only imperfect forms of the pore fungi, are with the genus *Cristella*, based by Patouillard on a *Clavaria*-like fungus having the above mentioned group of characters. The above combination has been proposed in an unpublished communication by M. A. Donk. The publication of this combination at this time is in line with other efforts at the clarification of the problem of "what is a *Poria?*" under discussion by a number of recent writers (**10**).

20. CRYPTOPORUS VOLVATUS (Peck) Hubbard.
Polyporus volvatus Peck.
Cryptoporus volvatus (Peck) Shear.

Common on *Abies concolor*, *Abies magnifica* var. *shastensis*, *Pinus ponderosa* and possibly other trees throughout the entire area of the mountain whether in dense forests or in groves or isolated trees in the chaparral areas. Included in the writer's exsiccati under the number *77*.

21. GANODERMA OREGONENSE Murrill.

Occasionally fructifications of this species, or their remains, are found on dead snags, stumps or drying trees of Shasta Fir. These fructifications are noteworthy for their large size, unsurpassed in the herbarium of the University of California, at least. A young specimen found Sept. 8, 1942 measured 8 inches in radius from the top of the stipe-like portion to the actively growing, thick, round front edge, and 6½ inches across at the widest point. The specimen was 4 inches thick with a tube layer, only in the early stages of development, 1 mm. deep. An old specimen was found on the same day which measured 17 inches from the top of the stipe-like portion to the front and 15 inches across the widest portion. The tubes of this specimen showed what appeared to be the result of two seasons of growth and were 1–1.5 cm. long where beetles had not eaten them away. The larger specimen had ceased growth at least one season before these observations were made. The lacquered top appears to develop in successive stages. On the young specimen the lacquering process was apparently complete on the oldest 4 inches while it was still in the process of development on the next 3 inches and apparently absent on the white to cream colored actively growing front region. A similar situation was noted on the older specimen which likewise had no varnish on the growing area although the fructification obviously had not been living within the past season.

22. LENZITES SAEPIARIA (Wulf.) Fries.

On one log of Shasta Fir cut from the forest during the construction of the Everett Memorial Highway this fungus has fruited on the sawed end two years in succession—1941 and 1942, although the log was cut in 1935. It has not been seen elsewhere on the mountain.

23. FOMES OFFICINALIS (Fries) Lloyd.

24. FOMES PINICOLA (Fries) Cooke.

These two species cause most of the heart rot of Fir and other coniferous trees on Mt. Shasta. They have been observed on *Abies concolor*, *Abies magnifica* var. *shastensis* and *Pinus lam-*

bertiana. Doubtless they occur on other hosts. Other fungi cause structural weakening of the larger forest trees (such as *Armillaria* sp.) but in a large percentage of the fallen logs observed the signs and symptoms observed point to the presence of one or the other of these two fungi in the heartwood before the tree had fallen.

25. FOMES SUBROSEUS (Weir) Overholts.

Although other fungi cause most of the heartrot observed on trees of Mt. Shasta this species is observed in fruit on occasional fallen logs and stumps.

26. POLYPORUS ELEGANS [Bull.] ex Fries.

Material sent to W. A. Murrill and determined by him as of this species has been collected three times in the vicinity of Mt. Shasta. It was found once on a rotting burl of *Prunus emarginata* which had been removed in a road widening project near Bear Springs. Again it was found among sticks on a hillside in the Squaw Valley Creek drainage among chaparral in a grove of scattered sugar and yellow pines. Again it was found on the ground under a cover of mature yellow pines and chaparral. It was not found above 6000 feet.

27. CORIOLUS ABIETINUS (Fries) Murrill.
Polyporus abietinus Dicks. ex Fries.
Hirschioporus abietinus (Fr.) Donk.

Commonly throughout the Shasta Fir forest this fungus has been found fruiting on old logs, stumps, and newly fallen branches and tree tops. I have seen and collected no typical material. It appears to become aborted, although fertile, either through shortness of growing period caused both by late snows and early drying out of substratum, or through irregularity of the substratum which, in some cases at least, has a definite effect on the shape of the sporophore. No resupinate material has been observed, the atypical form taking on rather a smaller size of pileate fructification. Bonar collected this species on *Abies magnifica* near Gold Lake in Plumas Co., July 28, 1942, where it grew largely in the resupinate habit although occasional aborted pileate speci-

mens were found. Material from Huntington Lake in Fresno Co. on *Pinus contorta* var. *Murrayana* in 1942 was also like the Shasta material. In contrast to these collections, on Mt. Diablo, Contra Costa Co., in February, 1942, the species was found on logs of *Pinus Sabiniana* and *Pinus Coulteri* in luxuriant, typical growth although the latter host had sporophores which were black-purple in color of the hymenium.

28. PORIA LENIS Karst.

Found occasionally in small to large sheets on the under side of Shasta Fir logs in the Horse Camp area. The lunar shape of the spores and the glistening pores which are sometimes slightly colored from white to cream or pinkish are characteristic. This has been issued in the writer's exsiccati as number *57*.

29. PORIA RUFA (Schrad. ex Fries) M. C. Cooke.

One collection of this fungus was made on a rotting log of *Pinus ponderosa* in the bottom of Bolam Creek canyon on the north side of Mt. Shasta.

30. PORODAEDALEA PINI (Fries) Murrill.

This fungus is represented on Mt. Shasta by the red ring rot disease it produces on Shasta Fir as well as by the occasional fruiting bodies found within Shasta Fir logs well on the final stages of decay. The type of fructification found is a thick, resupinate form of the fungus described under the name of *Trametes Pini* var. *Abietis* Karst.

31. SPONGIPORUS LEUCOSPONGIA (Cooke & Hark.) Murrill.
Polyporus leucospongia Cooke & Hark.

Throughout my collecting experience on Mt. Shasta this has been a conspicuous member of the polypore group. It grows on dead wood in almost all stages of decay on Shasta Fir, *Tsuga Mertensiana*, and *Pinus albicaulis*, as well as possibly on other hosts. It was found once, the only report so far as we have been able to discover on frondose wood, on a decaying stick of *Arctostaphylos patula* in a smothered patch of chaparral in a grove of young firs. On its normal hosts its lower altitudinal limits ap-

pear to be about 7000 feet. It is more common on the dead wood of the higher forests near economic timberline and in the fallen forests of avalanche areas. It also occurs on posts used as timbers and as trail markers. In this last instance it grew on a coniferous post at an elevation of 9000 feet considerably above the highest timber along the Summit Trail where the post was used as a mile post.

32. LAETIPORUS SULPHUREUS ([Bull.] ex Fries) Bond. & Sing.
Polyporus sulphureus [Bull.] ex Fries.
Laetiporus speciosus (Batt.) Murrill.

A number of immature sporophores assigned to this species by their general appearance, structure and consistency were found growing from the butt and trunk of a dead Shasta Fir in woods between Horse Camp and Panther Creek, Sept. 8, 1942. It had never been observed before on the mountain. The elevation was about 7500 ft.

Material of some of the above species has been distributed in the writer's exsiccati series now totaling 150 numbers. Material of all species listed here is in the writer's herbarium at the University of Cincinnati, while material of most of it has been sent to the University of California, the New York Botanical Garden, the Farlow Herbarium and the Mycological Collections of the Bureau of Plant Industry.

The writer wishes to express his appreciation of the assistance rendered by Dr. Donald P. Rogers of the American International College during the preliminary studies and preparation of this paper; to Dr. Lee Bonar for his kind permission to use space and materials in the Herbarium of the University of California; and to the Lloyd Library for bibliographic assistance. Dr. Harry R. Muegel of the Botany Dept., University of Cincinnati, very kindly assisted the writer with the Latin diagnoses.

BIBLIOGRAPHY

1. **Bondarzew, A. & Singer, R.** Zur Systematik der Polyporaceen. Ann. Myc. **39**: 43–65. 1941.
2. **Bresadola, G.** New species of fungi. Mycologia **17**: 68–77. 1925.
3. **Burt, E. A.** Hymenomycetous fungi of Siberia and Eastern Asia. Mo. Bot. Gard. Ann. **18**: 469–487. 1931.

4. **Burt, E. A.** Thelephoraceae of North America. *Stereum*. Mo. Bot. Gard. Ann.
5. **Cooke, W. B.** Flora of Mt. Shasta. Am. Midl. Nat. **23**: 497–572. 1940. First Supplement. Am. Midl. Nat. **26**: 74–84. 1941.
6. **Cooke, W. B.** Host Index of Mt. Shasta Fungi. Pl. Dis. Rept. Suppl. **123**. 1940. First Supplement. Pl. Dis. Rept. **25**: 61–62. 1941. Additions. Pl. Dis. Rept. **26**: 253–259. 1942. Mimeographed.
7. **Cooke, W. B.** Mycobiota of North America. *Fascicles* 1–5. 1939–42.
8. **Cooke, W. B.** Nomenclatorial survey of the genera of pore fungi. Lloydia **3**: 81–104. 1940.
9. **Cooke, W. B.** The problem of life zones on Mt. Shasta. Madrono **6**: 49–56. 1941.
10. **Cooke, W. B.** Resupinate pore fungi in Oregon. Am. Midl. Nat. **27**: 677–695. 1942.
11. **Donk, M. A.** Revision der Niederländischen Homobasidiomycetae—Aphyllophoraceae. Bot. Mus. Univ. Utrecht Med. **9**. 1933.
12. **Murrill, W. A.** North American Flora **9**: 1907–08.
13. **Rogers, D. P.** Relative dates of S. F. Gray's natural arrangement and Fries's systema. Mycologia **33**: 568–570. 1941.

A DASYSCYPHA FOLLOWING CRONARTIUM RIBICOLA ON PINUS MONTICOLA. II.

RICHARD T. BINGHAM AND JOHN EHRLICH

(WITH 2 FIGURES)

THE DASYSCYPHA ON PINUS MONTICOLA

A small-spored, white-excipled *Dasyscypha* on *Pinus monticola* has in several instances in the past been confused with *D. Agassizii* and *D. calyciformis*. Stillinger (**1929**: 579) reported that in 1924 he had collected *D. Agassizii* on dead branches of *Pinus monticola* in northern Idaho. The specimen (C. R. S. *2221*), originally identified by Dr. Wm. Diehl, on re-examination proves to be the *Dasyscypha* under consideration. Stillinger (**1929**: 580) at the same time reported three collections of *D. calyciformis*, one of which (C. R. S. *2602*), on *Pinus monticola* from British Columbia, has also been re-examined and found to be the same fungus. Referring to these latter specimens, Stillinger (*loc. cit.*) reported the fungus as occasionally found on blister rust cankers. In 1930 and 1931 Goodding and Hansbrough collected the fungus on blister rust cankers in Oregon and British Columbia, Hansbrough determining it to be *D. calyciformis*. It is not surprising that these fungi have been confused since *D. Agassizii* and *D. calyciformis* have not been adequately described until now. (Bingham & Ehrlich **1943**).

The *Dasyscypha* under consideration was first encountered by the writers during the course of a study on secondary fungi associated with blister rust cankers of *P. monticola*. Unlike the other secondary fungi encountered, the fungus was found to be abundant in every established blister rust center inspected in northern Idaho and northeastern Washington. Its present abundance is noteworthy since Stillinger (*loc. cit.*), only eight years after the discovery of *Cronartium ribicola* Fisch. in the Northwest, had reported *D. calyciformis* (in at least one instance actually the *Dasyscypha* in question) as only occasionally found on blister rust

cankers. Now this fungus is common on blister rust cankers in at least part of the region concerning which Stillinger had reported. It would seem that the fungus is endemic and has remained uncommon until the inroads of the blister rust disease have provided it with abundant infection courts in unhealthy and dead bark of *Pinus monticola*.

During the years 1940 to 1942 the fungus has been observed repeatedly, the substratum being in all cases the dead or weakened bark of *P. monticola*. Well over a hundred specimens have been collected and although a conscious effort was made to find this fungus on different substrata and on different hosts the effort has not been successful. Collections other than those made in connection with this study have been examined and found to be consistent in regard to substratum and host.

A description of the *Dasyscypha* on *P. monticola* which follows attempts to point out differences whereby this apparently undescribed fungus may be distinguished from its close, small-spored relatives *D. Agassizii* and *D. calyciformis*. The description is based on detailed study of thirty-five specimens, all but six of them on the bark of blister rust cankers.

THE DASYSCYPHA ON PINUS MONTICOLA.

Apothecia abundant, sub-phellar or shallowly intra-phellodermal; erumpent, gregarious or solitary, often two to several from a common base; *stipes* short to moderately long, up to 1 mm. long, each with one or a few cups; *cups* when young tightly closed, with age opening circularly and expanding under moist conditions to a saucer-like or disc-like shape with an even or undulating, thin margin; usually drying circularly but when large, particularly when overmature, by folding inward in several flaps; externally whitish with cylindrical, thin-walled excipular hairs (FIG. 4, *D*); *hairs* moderately to considerably roughened by minute tubercles, with unswollen or only slightly swollen, gently rounded tips, noticeably septate at intervals of from 10 to 25 μ, 2.5 to 4.5 μ broad, persistent even on the most mature and weathered apothecia, most abundant at the margins (FIG. 3, *C*); *discs* pale to bright orange, small to moderately large, 0.5–3.5 mm. wide, occasionally large, up to 5.5 mm. wide, when overmature the surface often reticulated; *hyphae* of the context variable in width, mostly 2.5–4.0 μ wide, irregularly swollen, much branched. **Asci** cylindrical to cylindric-clavate, with rounded or sub-acute apices, size

range (230) 45.0–72.0 × 3.5–7.0 μ, commonly 51–64 × 4.0–5.5 μ (FIG. 3, *A*). **Ascospores** eight, *arrangement* usually uniseriate, oblique, or oblique with the basal spores vertical, occasionally with a change in the direction of the oblique arrangement or biseriate; enclosing *membrane* rounded or sub-acute, following the contour of the ascus wall at the apex; *shape* usually subfusiform to long-elliptical, extreme range from subfusiform to ovate, usually with one end (the lower when in the ascus) more pointed; *walls* thin; *contents* hyaline, neither distinctly guttulate nor nucleate, continuous when in the ascus and upon germination; *germination* monopolar; *germ tubes* only slightly flexuous, soon branching, indistinctly septate at short (8–15 μ) intervals, 1–2 μ wide; *size* range (580) 4.5–8.5 × 2.0–3.0 μ, commonly 5.0–7.5 × 2.0–3.0 μ, twice seen up to 9.0 μ long and up to 3.5 μ wide (FIG. 3, *A* & *B*). **Paraphyses** usually exceeding the asci by from 5–15 μ, quite frequently branching near the base, slender; *shape* usually cylindrical or tapering very slightly to the base, occasionally slightly swollen near the tips, tips usually rounded, occasionally sub-acute; *contents* obscurely or noticeably septate, minutely guttulate, *size* range (190) 54.0–92.0 × 1.0–2.5 μ (at the widest point), commonly 60–75 × 1.0–2.0 μ, once seen up to 103.0 μ long and twice seen up to 3.0 μ wide (FIG. 3, *A*).

Imperfect fruiting bodies abundant, conspicuous, developing from light-colored, sub-phellar, erumpent stromata; with age becoming multi-loculate, and the outer wall and overlying bark more or less completely lost. The stromata may be seated at various depths in the bark tissues, particularly if the tissues contain fruiting stages (notably pycnia) of *Cronartium ribicola* (FIG. 4, *A* & *B*). **Conidiophores** erect, entirely lining the locules; simple or sparsely branched, noticeably septate, hyaline, minutely guttulate; bearing sparsely at the sides and sparsely or profusely at the apices the unicellular, curved, subulate spore-bearing elements (phialides). **Conidia** abstricted from the tips of the phialides, often exuded from the tops of the mature stromata in a whitish to brownish, translucent mass (FIG. 4, *D*, *c*); *shape* oblong, elliptical, ovate, or spherical, occasionally allantoid; *walls* thin; *contents* hyaline, continuous in the fruiting body and upon germination; *germination* monopolar; *germ tubes* straight, slender, 0.5–1.0 μ wide, unbranched and only occasionally septate after four days; *size* range 1.0–4.0 × 1.0–2.0 μ (FIG. 3, *D* & *E*).

SPECIMENS EXAMINED

Specimens believed to be the *Dasyscypha* in question, on *Pinus monticola:* R. T. Bingham *117A*, *151A*, *178*, *186*, *187*, *282*, *283*,

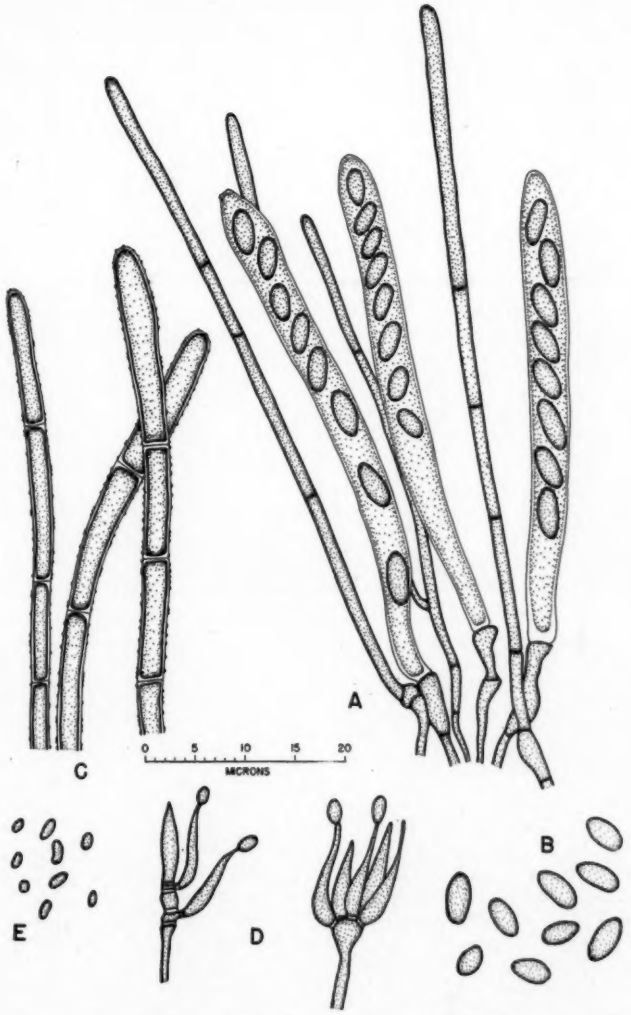

FIG. 3. The *Dasyscypha* on *Pinus monticola*. Drawings made with aid of a micro-projector, from University of Idaho Forest Pathology Herb. *2983*. *A*, asci and ascospores; *B*, ascospores; *C*, excipular hairs; *D*, conidiophores and phialides; *E*, conidia.

284, & *285;* C. R. Stillinger *2221* ("*D. Agassizii*"), *2602* ("*D. calyciformis*"), *3490*, *3512*, *3528*, *3574*, *3818*, *3846*, *3895*, *3901*, & *3908;* J. R. Hansbrough *578* & *579* (NY., "*D. calyciformis*"); University of Idaho Forest Pathology Herb. *1341*, *1347* ("*D. calyciformis*"), *1467* ("*D. calyciformis*"); *1966*, *2202*, *2825*, *2826*, *2829*, *2864*, *2983*, *2984*, *3364*, & *3365*.

HOSTS AND GEOGRAPHICAL RANGE

The *Dasyscypha* under consideration seems to occur exclusively on *Pinus monticola*. Although an effort has been made to find this fungus on other hosts in many of the localities where collections have been made it has not, as yet, been found on any of the usual associates of *P. monticola*. In several instances another *Dasyscypha*, close to *D. ciliata* Hahn (**1940**: 141–144), was found on *Abies grandis* (Univ. of Idaho Forest Path. Herb. *2828*).

The geographical range of the fungus on *P. monticola* can be said to cover a large part of the geographical range of its host. Specimens from Oregon, British Columbia, Washington, and Idaho have been examined. Due to the prevalence of *Cronartium ribicola* over the entire geographical range of *P. monticola*, and to the prevalence of the *Dasyscypha* in localities where suitable substrata (notably blister rust cankers) are present, it is presumed

FIG. 4. The *Dasyscypha* on *Pinus monticola*. *A* and *B*. Two parts of the same transverse section through infected bark, showing (*A*) an erumpent, subphellodermal, multi-loculate imperfect fruiting body of the *Dasyscypha* in the bark adjoining a pycnium (*p*) of *Cronartium ribicola*, and (*B*) a shallower, subphellar, multi-loculate imperfect fruiting body directly above the same pycnium (approx. × 100). *C*. Pure cultures in 2½ per cent malt agar slants (approx. × ½). Cultures originated from (*a*) several ascospores, (*b*) a single ascospore, (*c*) bark artificially inoculated with ascospores, (*d*) several conidia produced in culture, (*e*) a single conidium, and (*f*) naturally inoculated bark. All figured cultures had been growing for at least three months, with the exception of (*f*) which had been growing for less than three weeks. The hemispherical mound (*h*) to which the mycelium is often restricted during its early growth can be seen in (*e*). *D*. Habit, on a dead blister rust canker (approx. × 1½): (*a*) moistened, expanded, mature apothecia; (*b*) moistened, but still goblet-shaped, immature apothecia; (*c*) masses of conidia exuded from the imperfect fruiting bodies. *E*. Imperfect fruiting bodies produced on twigs of *P. monticola* protruding above malt-agar slants (approx. × 1): cultures originated from (*a*) bark, (*b* and *c*) several ascospores, and (*d* and *e*) a single conidium. The white nodules on the twigs are multi-loculate imperfect fruiting bodies from many of which conidia are exuding.

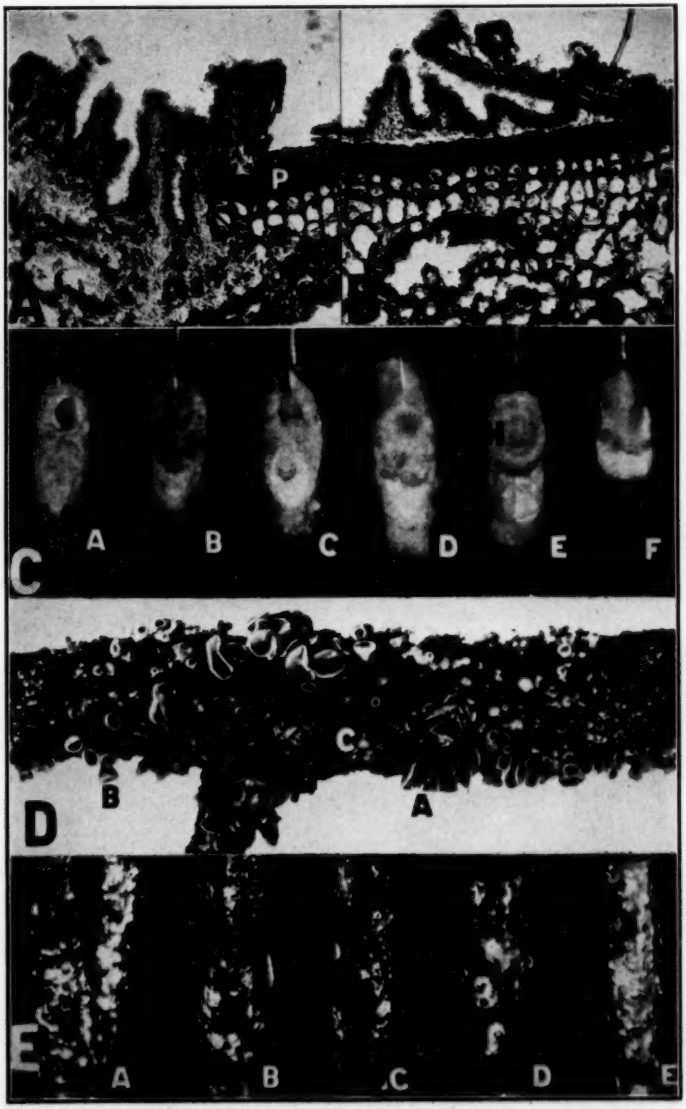

FIG. 4.

that the geographical range of the *Dasyscypha* is actually almost co-extensive with the geographical range of *P. monticola*.

PARASITISM

The *Dasyscypha* under consideration is undoubtedly a weak parasite (one incapable of initiating attack and invading only after the host tissues have been weakened by some other agency) or a saprophyte on *Pinus monticola*. In localities where *C. ribicola* is present it has usually been found on the live and dead blister rust cankers of *P. monticola*, while in localities where the rust is not present it has been found only on dead, wounded, or otherwise infected bark. It is noteworthy that where found as a weak parasite on blister rust cankers, the fungus is of some value as a biological control agent for the blister rust disease. Once established, it kills the bark much more rapidly than does *C. ribicola*, causing the premature death of cankered branches and thus blocking the advance of the rust into the trunk. Even more important, it reduces aecial sporulation of the rust.

DISCUSSION

The *Dasyscypha* on *Pinus monticola* may be distinguished from its close relatives *D. Agassizii* and *D. calyciformis* by its subfusiform to long-elliptical ascospores (the ascospores of both *D. Agassizii* and *D. calyciformis* are elliptical to plump-ovate) which are of intermediate length, by its lack of swollen paraphyses tips and flat-topped ascus membranes (characteristic of *D. Agassizii*), by its imperfect stage which is both conspicuous and abundant (not characteristic of either *D. Agassizii* or *D. calyciformis*), and by its restriction to *Pinus monticola* (both *D. Agassizii* and *D. calyciformis* occur on *Pinus* but most frequently on *Abies;* the latter has apparently not been reported on soft pines in Europe). It may be further distinguished from *D. calyciformis* by the ready germinability of its conidia. Plassmann (**1927**: 15–19) and Schellenberg (**1905**: 175) reported that the conidia of *D. calyciformis* could be germinated only infrequently and with great difficulty while the opposite has been found to be true of the *Dasyscypha* in question. Many of the cultures made during this study have, in fact, originated with conidia.

Hahn (**1940**: 138–144) has recently described two similar, new species of *Dasyscypha* on *Pseudotsuga taxifolia* (Lamb.) Britt. in the Pacific Northwest. One of these, *D. ciliata*, is easily distinguished from the *Dasyscypha* on *Pinus monticola* by the large size of the asci (63.0–92.8 × 6.0–12.0 μ) and ascospores (8.0–12.4 × 3.4–5.4 μ). The other, *D. Pseudotsugae*, is less easily distinguished from the *Dasyscypha* on *P. monticola:* the asci (47.0–60.0 × 3.4–5.4 μ) are only slightly smaller and the ascospores (3.8–7.2 × 1.8–3.6 μ) only slightly shorter than those of the *Dasyscypha* in question. However, the ascospores are often distinctly biguttulate and are uniseriately arranged in the ascus and the paraphyses are characteristically unbranched.[1] In addition, the differences in host, in geographical range (west of the Cascades), and in parasitism (apparent ability to induce cankers on a healthy host) should serve to distinguish *D. Pseudotsugae* from the *Dasyscypha* in question.

The conidial fruiting bodies resemble those of *D. calyciformis* and *D. Agassizii*. They are, however, conspicuous and abundant, usually being the only stage present on live blister rust cankers. The perfect stage does not form until the entire canker, or a considerable portion of the canker, has died.

CULTURE NOTES

More than 200 cultures of about 75 different isolates of the *Dasyscypha* on *Pinus monticola* have been under observation during 1940 to 1942. Monoascospore, multi-ascospore, monoconidium, multi-conidium, and bark cultures grew readily but slowly on 2½-per-cent-malt agar and on potato-dextrose agar. At the end of one month growth in unsealed Petri-dish cultures at room temperature almost ceased, apparently due to drying of the medium. Growth continued up to six months on malt-agar slants kept in a refrigerator at five to ten degrees Centigrade, the mycelium, in several instances, remaining viable for more than a year.

On the 2½-per-cent-malt agar slants the development of all types of isolates was similar (FIG. 4, *C*, *a–f*). The slow spreading azonate aerial mycelium was at first white, fine, cottony, moder-

[1] Examination of fresh material was made possible through the courtesy of Dr. Hahn and Dr. J. W. Kimmey.

ately dense, in small tufts up to one centimeter high, and often temporarily restricted to small hemispherical mounds (*h*), the vestiges of which were still visible in the older cultures (FIG. 4, *C*, *e*). The mycelium remained azonate but with increasing age became cream buff (Ridgway **1912**, pl. 30), matted, and dense with only a few small tufts of the original white, moderately dense mycelium remaining. Within fifteen to twenty-five weeks the mycelium in the malt-agar slants became congested in small, inconspicuous nodules, or stromata. The stromata, however, did not become loculate or produce conidia, the medium in the unsealed slants apparently becoming too dry to support further growth of the culture. Certain color changes were noted in the malt agar supporting growth of the fungus: pigmentation was always present, ranging from tawny at the center of the colony to orange buff and then to pale orange yellow (*ibid.*, pl. 3, 15) at the edges of the colony, starting a few weeks after inoculation of the slant and spreading with enlargement of the central tawny zone.

Microscopically, the mycelium from all types of isolates was similar. Commonly it consisted of long, somewhat flexuous, narrow (0.5–1.0 μ) hyphae which were septate and branched with moderate frequency at acute to right angles. Occasionally there were broader (2.0–2.5 μ) hyphae with infrequent, bulbous swellings up to 4.5 μ wide. Anastomoses were not uncommon.

Mature, multi-loculate imperfect fruiting bodies with viable conidia developed on *Pinus monticola* twigs which had been added to the standard 2½-per-cent-malt agar slants before autoclaving. The mycelium spread rapidly over the lower portion of the twigs and within as little as 7½ weeks became congested in relatively large, conspicuous stromata. Within as little as 14½ weeks mature, imperfect fruiting bodies formed on the surface of the pine twigs (FIG. 5, *E*, *a–e*). These superficial bodies exuded conidia from the locules in large, translucent, yellowish-white tendrils. They continued to mature and produce conidia until the cultures dried. In one twig slant, after forty-four weeks, subphellar or intra-phellodermal imperfect fruiting bodies were found in the bark near the tops of the twigs. Paired twig slants, one with the usual cotton plug and one with the cotton plug sealed over with parafilm, were used in each instance. It was noticed that the

sealed slants produced a greater number of larger and more heavily sporulating imperfect fruiting bodies. It was noteworthy that sporulating bodies were not produced in the standard malt-agar slants while on twig slants they were produced in every case and within as short a period as 14½ weeks. Hahn (**1934**: 93), on the other hand, reported the development of sporulating bodies in 3-per-cent-malt agar slants by four different large-spored species of *Dasyscypha*.

Apothecia were not produced in culture. Observation periods for malt-agar slants were as long as 135 weeks and for twig slants as long as 125 weeks. Cultures were frequently moved between a dark refrigerator, at a temperature of five to ten degrees Centigrade, to a day- or artificially lighted cabinet, at room temperature. Neither the changing conditions of light and temperature nor the drying of the medium helped in stimulating perfect-stage fruiting.

SPORE GERMINATION

The germination of ascospores and conidia in water was studied in Van Tieghem cells. Ascospore germination was observed several times; conidium germination, only once in the hanging-drop cultures, at which time close examination was made difficult by the small size of the conidia and germ-tubes as well as by Brownian movement of the conidia. Both ascospores and conidia were frequently observed during germination on filtered-agar plates used for making single-spore cultures.

Ascospores germinated three to eight days after sowing. The germ-tubes were monopolar and narrow (0.5–1.0 μ wide); they grew slowly, within a few days developing branches and indistinct septa. Three to four days after germination the germ-tubes became slightly flexuous and the septa became more distinct. Branching was at no time profuse nor did the germ-tubes ever become more than slightly flexuous. Ascospores were also observed germinating within the ascus, the germ-tubes soon piercing and protruding from the ascus wall.

Conidia, where once closely examined, were found to germinate within four days by monopolar, very narrow (0.5 μ wide), straight germ-tubes. Some swelling preceded germination. The germ-tubes, from this stage on, developed much as did the ascospore

germ-tubes, becoming septate, branched, slightly flexuous, and of greater width.

INOCULATIONS

More than two-hundred inoculations were made on *Pinus monticola* during the years 1940 to 1942. The purpose of these inoculations was to ascertain whether the *Dasyscypha* can enter intact bark, to ascertain the points in the development of blister rust cankers at which the *Dasyscypha* gains entrance, and to study the subsequent development of the *Dasyscypha* and its lesion. A system of quadruplicate inoculations was devised, wherein artificially wounded and unwounded blister rust cankers representing two different developmental stages of *C. ribicola* were inoculated with mycelium, ascospores, and conidia.

Unfortunately, the inoculations were almost entirely unsuccessful: only four reisolations, attempted from seven to fifteen weeks after inoculation, were obtained. In many instances small lesions, apparently caused by the inoculated fungus, developed for a short time about the points of inoculation, then ceased development. In the majority of cases these lesions were in blister-rust infected or otherwise wounded bark, particularly when the bark had been inoculated with ascospore or conidium suspensions using a hypodermic syringe and a fine, non-clogging, side-issue needle like that introduced by Ivanoff (**1934**: 74, FIG. 1, *A*) and improved by Dr. L. J. Tyler and Dr. K. G. Parker of Cornell University.

It was believed that exposure of inoculum and infection courts to fluctuating high temperatures and low humidities immediately following a five-day initial incubation period was the main cause of failure. This conclusion is strengthened by the fact that the *Dasyscypha* is most prevalent in the field on moister, shaded sites and is often entirely absent on drier, unprotected sites.

PATHOLOGY

The *Dasyscypha* was frequently found in the field fruiting on sunken necrotic portions of live blister rust cankers. When found on live cankers the imperfect stage usually predominated; on dead cankers the perfect stage was most prevalent. The fungus was isolated repeatedly from the bark at the margins of lesions on live cankers and it was, therefore, presumed to be the probable

cause of these lesions. The lesions had a distinct and slightly raised margin indicating that the causal fungus had incited wound responses. Microscopic examinations of transverse sections cut from the margins of lesions bearing conidial fruiting bodies of the *Dasyscypha* confirmed this conclusion.

The necrotic portions were composed of degenerated cortical and phloem cells in which the protoplasmic contents had disappeared or shrunken and the walls had been distorted or had collapsed. The margins of the lesions were bordered by a wound-phellem, several to many cells thick, produced by an active wound-phellogen in which parenchymatous cortical cells were dividing and being cut off in the plane of the lesion margin. The thick-walled, narrow, corky cells of the wound-phellem were quite similar to the cells of the normal phellem layer produced at the healthy bark surface. At the junction of the bark surface and the lesion margin, in fact, the two phellem layers were indistinguishable except for the fact that the wound phellem was underlain by a more conspicuous and actively dividing phellogen.

The inner margins of older lesions, advancing in the radial direction toward the xylem tissues, were faced along a relatively smooth line by the wound-phellem and active wound-phellogen. In still older lesions the margins had reached the xylem tissues, ceased advancing in the radial direction, and spread tangentially faced by a similar phellem and phellogen.

Mycelium was not plentiful, except at the surfaces of the lesions, and then only at the bases of the erumpent imperfect fruiting bodies. Near these the degenerated cells and intercellular spaces were crowded with fine, branching hyphae but deeper in the bark only occasional, single hyphae were seen crossing cell lumina. No aggregation of hyphae was seen at the inner lesion margins. Hyphae of *Cronartium ribicola* in the dead tissues were relatively scarce, often collapsed, and presumably dead, while immediately behind the actively dividing cells of the wound-phellogen, in the live tissues, the hyphae of *C. ribicola* were abundant.

The formation of wound-phellem varied apparently depending on the rate of advance of the lesion margins. In a few instances lesion margins were seen which were not yet opposed by a definite wound-phellem but which were entirely bordered by an actively dividing wound-phellogen. In other instances, lesion margins

were seen which had advanced over well established wound-phellem layers, accompanied by the formation of new wound-phellogens bordering the area of latest encroachment. These facts seem to indicate that lesion advancement is also variable, possibly greatest at certain seasons when the rate of wound-phellem formation cannot keep pace with the rapidly advancing lesion margins. Langner (**1936**: 145) reported that a corky layer in *Larix* bark was, likewise, unable to prevent advance of *D. Willkommii*. He also reported (*ibid.*: 144) that the hyphae could not penetrate living bark but that their presence in adjoining dead bark so sensitized the living bark that it was frost-killed, allowing their subsequent further spread. This may also be true of the *Dasyscypha* on *Pinus monticola*.

The hyphae of the obligate parasite *Cronartium ribicola* cause no immediate necrosis and incite no cork formation in bark tissues; the hyphae of the facultative parasite *Dasyscypha*, in contrast, apparently cause necrosis and incite wound-cork formation in the bark tissues. Metabolic products of the *Dasyscypha* are thus apparently at once more stimulatory and more toxic than those of the *Cronartium*. Curiously, despite the added resistance of the wound-phellem layer, lesion development is rapid and results in death of the bark tissues in that portion of a blister rust canker which would normally be the first to produce pycnia and aecia of the rust.

DISCUSSION AND CONCLUSIONS

The small-spored, white-excipled *Dasyscypha* on *Pinus monticola* has been compared with *D. Agassizii* and *D. calyciformis*, with both of which it has heretofore been confused. The differences which are now recognized between the three fungi are tabulated below.

The *Dasyscypha* on *Pinus monticola* can thus be readily distinguished from *D. Agassizii:* it has unswollen paraphyses, round-topped ascus membranes, apothecia with relatively short stipes and narrow discs, and an abundant and conspicuous imperfect stage with subulate phialides; *D. Agassizii*, on the other hand, has swollen paraphyses, flat-topped ascus membranes, apothecia with relatively long stipes and broad discs, and an infrequent and inconspicuous imperfect stage with moniliform or slightly subulate

	D. calyciformis	The *Dasyscypha* on *Pinus monticola*	*D. Agassizii*
Apothecia			
No. from a common base	1 or a few	1 or a few	1 to more than 12
Width of discs	0.5–2.0 mm.	0.5–3.5 mm.	0.5–5.5 mm.
Length of stipes	Short	Up to 1 mm.	Up to 2.5 mm.
Excipular hairs	Persistent	Persistent	Lost with age
Asci			
Membrane	Round-topped	Round-topped	Flat-topped
Length	36.0–58.5 μ	45.0–72.0 μ	43.5–67.5 μ
Width	4.0– 6.0 μ	3.5– 7.0 μ	4.0– 6.0 μ
Ascospores			
Shape	Elliptical to plump-ovate	Subfusiform to long-elliptical	Elliptical to plump-ovate
Contents	Indistinctly biguttulate and nucleate	Neither biguttulate nor distinctly nucleate	Indistinctly biguttulate and nucleate
Length	4.0–7.5 μ	4.5–8.5 μ	5.0–9.5 μ
Width	1.5–3.5 μ	2.0–3.0 μ	2.0–4.0 μ
Paraphyses			
Tips	Usually unswollen	Usually unswollen	Usually swollen
Length	45.0–77.0 μ	54.0–92.0 μ	47.5–94.5 μ
Width	1.0– 3.0 μ	1.0– 2.5 μ	1.0– 3.5 μ
Imperfect fruiting bodies			
Stromata	Inconspicuous, infrequent	Conspicuous, abundant	Inconspicuous, infrequent
Phialides	Subulate	Subulate	Moniliform or slightly subulate
Exuded spore masses	Not seen	Common	Rare
Germinability of conidia	Inconsistent	Consistent	Not known
Hosts	*Abies;* less commonly *Pinus,* et al.	*Pinus monticola*	*Abies;* less commonly *Pinus,* et al.
Geographical range	Europe; N. Zeal.[2]	NW. N. America	NE. N. America

[2] On *Pinus Banksiana* Lamb., *P. Laricio* Poir., *P. ponderosa* Dougl., and *P. radiata* Don. *Vide:* Entrican, Alex T., p. 7, *in* Annual report of the director of forestry for the year ended 31st March, 1942. New Zealand State Forest Service, 20 p. 1942.

phialides. The *Dasyscypha* on *Pinus monticola* is less readily distinguishable from *D. calyciformis:* it has an abundant and conspicuous imperfect stage with readily germinable conidia; *D. calyciformis*, in contrast, has an infrequent and inconspicuous imperfect stage with conidia which have been induced to germinate only with difficulty. Hosts and geographical range provide a convenient means for distinction: the *Dasyscypha* in question has been seen only on *Pinus monticola* in northwestern United States and British Columbia; *D. calyciformis* is known principally on *Abies* in Europe; and *D. Agassizii* is known principally on *Abies* in northeastern North America.

In order to test the value of ascospore and ascus measurements as an aid in distinguishing these fungi, means of one-hundred measurements, from five to ten collections of each species, were compared as follows:

	Dasyscypha calyciformis		The *Dasyscypha* on *P. monticola*		*Dasyscypha Agassizii*
	Microns		*Microns*		*Microns*
Ascospore length					
Mean ± S.E.[3]	5.8 ± .078		6.0 ± .092		6.7 ± .088
Difference		0.2		0.7	
S.E. of Diff.		0.12		0.13	
Significance [4]		1:1–5:1		>99:1	
Ascospore width					
Mean ± S.E.	2.4 ± .034		2.4 ± .034		2.9 ± .036
Difference		0.0		0.5	
S.E. of Diff.		—		0.05	
Significance		—		>99:1	
Ascus length					
Mean ± S.E.	49.0 ± .437		57.9 ± .405		55.3 ± .390
Difference		8.9		2.6	
S.E. of Diff.		0.60		0.56	
Significance		>99:1		>99:1	
Ascus width					
Mean ± S.E.	4.5 ± .041		4.7 ± .038		4.8 ± .041
Difference		0.2		0.1	
S.E. of Diff.		0.056		0.056	
Significance		>99:1		20:1–99:1	

[3] Standard error of the mean.

[4] Significance is expressed in odds that the calculated differences between means could not have arisen by chance from samples of a single universe and thus indicate the probability that the contrasted means are in fact significantly different. The odds shown were obtained by means of the "*t* test."

Although the means of these measurements lie close together, it is evident that such measurements will serve to distinguish the three fungi. The *Dasyscypha* on *P. monticola* cannot be distinguished from *D. calyciformis* by ascospore measurements but can be readily distinguished on the basis of ascus length. On the other hand, while it can hardly be distinguished from *D. Agassizii* by ascus measurements, these two fungi can be readily distinguished on the basis of ascospore measurements. Save for the differences between the means of ascospore measurements for the *Dasyscypha* on *P. monticola* and *D. calyciformis*, the differences between means are all significant.

On the basis of these differences, as well as of others discussed above, the *Dasyscypha* on *P. monticola* appears to be distinct from both *D. calyciformis* and *D. Agassizii*. Since it has not been possible to compare large numbers of collections on various hosts, both morphologically and culturally, the fungus on *P. monticola* is not proposed as a new species.

SUMMARY

A small-spored, white-excipled *Dasyscypha* frequently found associated with blister rust cankers on *Pinus monticola* in the northwestern United States has, in the past, been confused with *D. Agassizii* and *D. calyciformis*. Specimens of the three fungi were examined and their morphological features, hosts, geographical ranges, and parasitism were compared. In addition, cultural and pathological studies of the *Dasyscypha* on *Pinus monticola* were made.

As a result, the fungus is considered distinct from *D. Agassizii* and *D. calyciformis*. In view of the fact that it was not possible to compare large numbers of collections of the three fungi on various hosts, both morphologically and culturally, the *Dasyscypha* on *Pinus monticola* was not proposed as a new species.

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LITERATURE CITED

Batsch, A. J. G. Elench. Fung. Contin. 1: 183 p. 1786.

Berkeley, M. J. Notices of North American fungi (Continuation). Grevillea 3: 145–160. 1875.

Bingham, Richard T. & John Ehrlich. A *Dasyscypha* following *Cronartium ribicola* on *Pinus monticola*. I. Mycologia 35: 95–111; *2 fig.* 1943.

Bisby, G. R. The fungi of Manitoba and Saskatchewan. Ottawa: National Research Council of Canada; 189 p. 1938.

Briquet, John. International rules of botanical nomenclature. Jena: G. Fischer; 152 p. 1935.

Dillenius, Johann Jacob. Cat. Pl. Grissa; 240 p. 1718; App. (174 p., *16 pl.*). 1719.

Ehrlich, John. Forest pathology in Nova Scotia. Province of Nova Scotia, Dept. Lands and Forests, Report for **1931**: 36–45; *fig. 1–6.* 1932.

Ewan, Joseph. Isotype versus co-type as designations for duplicate type. Chron. Bot. **7**: 8–9. 1942.

Falck, R. Tannensterben in der Eifel. Forstarchiv **3**: 397–409; *4 fig.* 1927. (*From* Rev. Appl. Myc. **7**: 349–350. 1928.)

Feltgen, Joh. Vorstudien zu einer Pilzflora des Grossherzogthums Luxemburg. 3. Luxemburg; 328 p. 1903.

Ferdinandsen, C. Nye erfaringer om vitigere snyltesvampe i vore skove. Dansk Skovforenings Tidsskrift **1928**: 275. 1928. (*From* Zeits. Pflanzenk. **41**: 358. 1931.)

Fries, Elias Magnus. Syst. Myc. **2**: 275 p. 1822.

Fuckel, Leopold. Symbolae mycologicae. Beiträge zur Kenntniss der rheinischen Pilze. Jahrb. Nass. Ver. Nat. **23–24**: 1–459; *6 pl.* 1869/70.

Gleditsch, Johann Gottlieb. Methodus fungorum exhibens genera species et varietates, cum charactere differentia specifica, synonymis, solo, loco et observationibus. Berolini; 162 p., *6 pl.* 1753.

Hahn, Glenn Gardner. *Dasyscyphae* on conifers in North America. IV. Two new species on Douglas fir from the Pacific Coast. Mycologia **32**: 137–147; *fig. 1–2.* 1940.

Hahn, Glenn Gardner & Theodore T. Ayers. *Dasyscyphae* on conifers in North America. I. The large-spored, white-excipled species. Mycologia **26**: 73–101; *pl. 8–13.* 1934.

Ivanoff, S. S. A plant inoculator. Phytopathology **24**: 74–76; *fig. 1.* 1934.

Jørstad, Ivar. Norske skogsykdommer. I. Nåletresykdommer bevirket av rustsopper, ascomyceter og fungi imperfecti. Norske Skogforsøksvaesen, Meddelelser **6**: 19–186. (English summary, 156–175.) 1925.

Jørstad, Ivar. Innberetning fra statsmycolog Ivar Jørstad om soppsykdommer på skogtraerne i årene 1926–1930. Norske Skogvaesen, Beretning **1930**: 78–96. 1931.

Karsten, P. A. Revisio monographica atque synopsis Ascomycetorum in Fennia hucusque detectorum. Acta Soc. Fauna Fl. Fenn. **2**[6]: 1–174. 1885.

Langner, W. Untersuchungen über Lärchen-, Apfel- und Buckenkrebs. Phytopath. Zeits. **9**: 111–146; *6 tab., 11 fig.* 1936.

Lanjouw, J. On the standardization of herbarium abbreviations. Chron. Bot. **5**: 142–150. 1939.

Ludwig, F. Dendropathologische Notizen. Forstlich-Naturwiss. Zeits. **3**: 337–338. 1894. (*From* Zeits. Pflanzenk. **6**: 95. 1896.)

Mason, E. W. Annotated account of fungi received at the Imperial Mycological Institute, Kew. List **II** (Fascicle 3—General Part): 69–99; *fig. 20–30.* 1937.

Maublanc, A. A propos du *Dasyscypha calyciformis* (Willd.). Bull. Soc. Myc. Fr. **20**: 232–235; *fig. 1–8*. 1904.

Noack, M. p. 707, *in* Sorauer, Handbuch der Pflanzenkrankheiten, ed. 6, **II** (1). Berlin: Paul Parey; vii & 758 p. 1928.

Oudemans, C. A. J. A. Enumeratio systematica fungorum. Vol. **I**. Hagae: Martinum Nijhoff; cxxvi & 1230 p. 1919.

Plassmann, Eberhard. Untersuchungen über den Lärchenkrebs. Neudamm: J. Neumann; 88 p., *20 fig.* 1927.

Plassmann, Eberhard. Zum Tannensterben in der Eifel. Zeitschrift für Forst- und Jagdwesen **60**: 272–283; *4 pl.* 1928. (*From* Rev. Appl. Myc. **7**: 686–687. 1928.)

Rehm, H. Ascomyceten: Hysteriaceen und Discomyceten. *In* Rab. Krypt.-Fl., ed. 2. Leipzig: Eduard Kummer. 1 (3): 1275 p.; *fig.* & index 169 p. 1887–1896.

Ridgway, Robert. Color standards and nomenclature. Washington, D. C.: Published by the author; iii & 43 p., 7 *tab.*, *53 pl.* 1912.

Saccardo, P. A. Syll. Fung. **8**: xvi & 1143 p. 1889.

Schellenberg, H. C. Das Absterben der sibirischen Tanne auf dem Adlisberg. Schweizerische Centralanstalt für das Forstlich Versuchwesen. Mitteilungen **8**: 269–287; *pl. 1–2*. 1905.

Schumacher, Christian Friedrich. Enum. Pl. Saell. **2**: 489 p. 1803.

Seymour, Arthur Bliss. Host index of the fungi of North America. Cambridge: Harvard University Press; xiii & 732 p. 1929.

Snell, Walter H. *Dasyscypha Agassizii* on *Pinus Strobus*. Mycologia **21**: 235–242; *pl. 20*. 1929.

Stillinger, C. R. *Dasyscypha fusco-sanguinea* Rehm on western white pine, *Pinus monticola* Dougl. Phytopathology **19**: 575–584; *fig. 1*, *pl. 12*. 1929.

Strasser, P. Pius. Zweiter Nachtrag zur Pilzflora des Sonntagberges (N. Österreich). Zool.-Bot. Gesell. **52**: 429–437. 1902.

Wagner, G. Beiträge zur Kenntnis der Pflanzenparasiten. Zeits. Pflanzenk. **6**: 321. 1896. (*From* Noack, 1928.)

Willdenow, Carl Ludwig. Fl. Berol. xvi & 439 p., 7 *tab.* 1787.

Wilson, Malcolm. Notes on new or rare British fungi. Trans. Brit. Myc. Soc. **7**: 79–85. 1921. (*From* Bot. Abstr. **10**: 187. 1922.)

Zederbauer, E. Fichtenkrebs. Centralblatt für das Gesamte Forstwesen, Wien **32**: 1. 1906. (*From* Zeits. Pflanzenk. **17**: 120. 1907.)

STUDY OF BAGNISIOPSIS SPECIES ON THE MELASTOMACEAE

JULIAN H. MILLER AND M. GWENDOLYN BURTON

(WITH 23 FIGURES)

This is a group of interesting fungi occurring on living leaves of various genera and species of the Melastomaceae in tropical America. In the revision of the genus by Petrak (**5**) species parasitizing this family are placed in the section *Eu-bagnisiopsis*, and this paper is confined to a study of that section.

Many published descriptions are to be found rather widely scattered throughout the literature. It has been the purpose of this investigation to bring these together with a key and descriptions. Several names have been reduced to synonymy, and one new description added.

Most of the specimens studied have been collections of Drs. C. E. Chardon, A. S. Muller, R. A. Toro, and Prof. H. H. Whetzel, gathered in many mycological explorations in Central and South America and the West Indies. In addition to these the writers have been most fortunate in being able to see those in the Theissen herbarium at Harvard University.

The writers wish to acknowledge their appreciation for the loan of specimens to Dr. D. H. Linder, Farlow Herbarium, Harvard University, Dr. F. J. Seaver, New York Botanical Garden, Mr. J. A. Stevenson, U. S. D. A. Mycological Collections, Prof. H. H. Whetzel, Cornell University, and to Dr. C. E. Chardon for specimens from his private herbarium.

BAGNISIOPSIS Theiss. & Sydow, Ann. Myc. **13**: 291. 1915.
Dothidina Theiss. & Sydow, Ann. Myc. **13**: 302. 1915.
Haplostroma Sydow, Ann. Myc. **14**: 80. 1916.
Sucinaria Sydow, Ann. Myc. **23**: 363. 1925.
Type: *Bagnisiopsis tijucensis* Theiss. & Sydow.

Stroma pulvinate, erumpent-superficial, dothideoid, locules immersed, or rarely with vertices partially free. Asci with paraphysoids, 8-spored. Spores uniseriate, continuous, elliptical to

spherical, hyaline, finally becoming brown. Conidia filiform, hyaline, borne in locules in a superficial stroma.

The species of this genus are all parasitic on leaves. A stroma originating in the mesophyll, proliferates through the lower epidermis, forming a sessile, slightly hemispheric, superficial portion continuous with the hypostroma. Then flask-shaped spermagonia, partially free, appear on this stroma. These have been filled with spermatea, and at the same time below in the center of the stroma, there are very delicate hyphae surrounding portions of a larger, deeply staining thread, which is probably the archicarp. Then, later stages of the stroma (FIG. 11) were found with spermagonia above and young locules containing ascal initials. This phase was not investigated further because of the lack of fresh material.

The conidia are borne in a superficial stroma resembling that of the ascigerous stage, and occasionally both are found in the same stroma. This asexual stage falls within the form genus *Hemidothis*. Sydow (**10**) erected it with the single species *Miconiae*, on *Miconia* sp., and Petrak (**4**, **6**) showed the connection with *Bagnisiopsis*.

The mature ascal stroma in *Bagnisiopsis* has no characteristic shape, varying from a regular cupulate disc to an irregular pulvinate mass, and from containing single locules to many, all on the same leaf. Also, the dimensions of the ascospores are more variable than in most Ascomycetes previously studied by the writers. These facts probably account for the many species in the literature.

In this section of *Bagnisiopsis* there does not seem to be any limitation of species to either genera or species of the Melastomaceae.

Theissen and Sydow (**11**) created *Bagnisiopsis* to include hyaline spored forms with locules in a dothiodeoid stroma, with paraphyses, and at the same time erected *Dothidina* for similar forms with colored spores. Later Petrak (**5**) discovered that the ascospores of the type of the former finally become brown and merged the two genera.

The genus *Sucinaria* was placed in the Hypocreales by its author, Sydow (**8**), with all of the characters of *Bagnisiopsis*

except the fleshy, light colored stroma. The centrum characters, as well as most of those of the stroma, are typical of the *Bagnisiopsis* group with surface projections, and the light colored stroma is not sufficient to place it in a separate order. Petrak (**5**) recognized this relationship with *Bagnisiopsis* by pointing out that both groups grow on the same hosts and both are parasitized by *Protoscypha pulla* Sydow. Clements and Shear (**3**) place *Sucinaria* in the Hypocreales, but the writers see no distinction from *Bagnisiopsis* and reduce it to synonymy.

Petrak (**5**) divides *Bagnisiopsis* into three sections as follows:

1. Section *Eubagnisiopsis*. This includes typical forms growing on the Melastomaceae. Stromal tissue chiefly thread-like, often only the outer crust plainly cellular, rather fleshy, gelatinous or cartilaginous-fleshy, more or less bright colored inside and surrounded by a thin, dark colored layer. Spores somewhat small and usually not over 20 μ in length.

2. Section *Phoenicostroma* (Sydow) Petrak. The species that belong here grow on palm leaves, and are characterized by the lower part of the stroma strongly developed, more or less prosenchymatous, entirely opaque-black or dark brown, brittle carbonous. Spores usually over 20 μ long.

3. Section *Chaetobagnisiopsis* Petrak. These forms are separated by the presence of setae either only on the edge of the stroma or irregularly scattered over the surface. Spores apparently remaining hyaline.

The stromal characters of the species in the section *Phoenicostroma* are so distinct from those on the Melastomaceae that it seems best to continue the group as a genus distinct from *Bagnisiopsis*.

Petrak's other section, *Chaetobagnisiopsis*, contains only two species, *B. polymorpha* (Stevens) Petrak, and *B. nuda* (Stevens) Petrak. He thinks their relationships lie with *Bagnisiopsis*, but as they do not occur on the Melastomaceae they are not included in this study.

Theissen and Sydow (**11**), as well as Clements and Shear (**3**), place *Bagnisiopsis* in the Dothideales, but Petrak (**4**, **5**) concludes that the genus is closely related to *Phyllachora* through the type of ascospores and conidia, and differs only in the stroma

being superficial, and that both belong in the Sphaeriales. The writers, however, think the absence of a special wall to the locules (FIG. 9) and the presence of paraphysoids, definitely separate it from *Phyllachora* and place it in the Pseudosphaeriales.

Bagnisiopsis is distinct from the Dothideales in possessing a wall layer of asci, rather than the fascicle, and in the filiform threads between the asci.

The relationships of *Bagnisiopsis* are with such genera as *Botryosphaeria*, *Physalospora*, *Cucurbitaria*, *Pleospora* and others. It is separated from the most closely related genus, *Botryosphaeria*, by filiform conidia, asci not thickened at the tips, and the finally superficial stroma.

KEY TO THE SPECIES OF SECTION *Eubagnisiopsis*

Stroma black, coriaceous	
Stroma without seta-like processes	
Ascospores elliptical	
Spores 8–15 × 4–7 μ	1. *B. Leandrae*
Spores 11.4–17 × 7.6–12 μ	2. *B. tijucensis*
Spores 13.3–24 × 7.6–12 μ	3. *B. peribebuyensis*
Ascospores sphaerical	
Spores 7.6–11.4 μ	4. *B. sphaerospora*
Stroma with such processes	
Spores 7.6–16 × 7.6–11.4 μ	5. *B. Toledoi*
Spores 11.4–22.8 × 7.6–11.4 μ	6. *B. amadelpha*
Stroma translucent, pale brown, fleshy with processes	
Spores 8–10 × 6.5–7.5 μ	7. *B. minuta*
Spores 11.4–19 × 7.6–9.5 μ	8. *B. translucens*

1. **Bagnisiopsis Leandrae** (Sydow) comb. nov.

Auerswaldia Leandrae Sydow, Hedwigia **40**: 2. 1901.

Auerswaldia Miconiae P. Henn. Hedwigia **43**: 253. 1904.

Rosellinia Miconiae (P. Henn.) Hohnel, Sitz-ber. Akad. Wien. **118**[1]: 828. 1909.

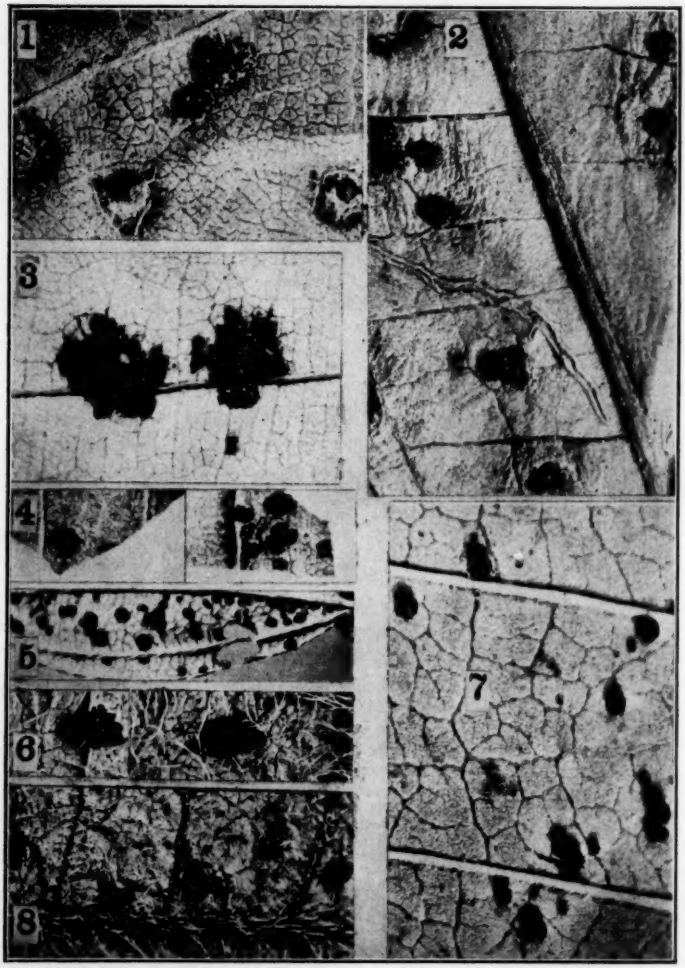
Dothidina Leandrae Sydow, Ann. Myc. **13**: 302. 1915.

Dothidina Miconiae (P. Henn.) Theiss. & Sydow, Ann. Myc. **13**: 303. 1915.

Bagnisiopsis minutula Petrak, Hedwigia **68**: 278. 1928.

Type: Material on *Leandra cordifolia*, leg. Reineck, Rio Grande do Sul, Brazil, 1897, at Harvard herb.

Stromata hypophyllous, in poorly defined spots, closely aggregated or coalesced, in groups or widely scattered, erumpent-superficial, pulvinate-irregular or disciform, cupulate or appla-



FIGS. 1–4. *Bagnisiopsis peribebuyensis*. Enlargements of stromata. 1, Balansa no. *3479*, × 8; 2, Chardon no. *1055*, × 8; 3, Muller no. *508*, × 8; 4, Balansa no. *3894*, type, × 2; 5, *B. tijucensis*, Rehm Ascom. no. *1542*, type, × 2; 6, *B. sphaerospora*, Toro no. *314*, type × 12; 7, *B. amadelpha*, Chardon and Nolla no. *443*, × 12; 8, *B. translucens*, Whetzel and Muller no. *3010*, type, × 12.

nate, slightly constricted at the base, .3–.8 mm. in diam., passing into the hypostroma, with surface black, even or irregular; locules one to many, sunken in the stroma, rarely projecting, globose to angular from mutual pressure, with no special wall, 150–240 μ in diam., with conical ostiole, immersed; asci cylindrical with uniform walls, p. sp. 60–86 × 7–11 μ, with attenuated stipe 60–90 μ in length; ascospores continuous, narrowly elliptical to broadly ovate, rounded at ends, with uniform epispore, .5 μ thick, hyaline becoming yellowish-brown, 8–15 × 4–7 μ; paraphysoids numerous, filiform.

Conidia in cavities in stromata, hyaline, filiform, 15–24 × 1.2 μ.

Hosts: *Leandra cordifolia*, *Miconia* sp. (*Miconia Pilgeriana* sec. Ule).

Distribution: Brazil.

This species is distinguished from *B. tijucensis* chiefly through the possession of smaller spores. The same variations in shapes of the stroma are found in both.

Petrak (**5**) has this species under *B. minutula*. He changes the Henning's name *Miconiae* to *minutula* because of the earlier *Sphaeria Miconiae* Duby. Then he places *D. Leandrae* under *B. Sellowii* as a synonym. However, he saw only specimens determined as *D. Leandrae* by Sydow, and they were either sterile or immature.

The spores of *B. minutula* are given by Petrak (**5**) as 8–12 × 5.5–7 μ; while Theissen and Sydow, under *D. Miconiae*, have them 11–13 × 6–7 μ. The latter give those of *D. Leandrae* as 13–16 × 4–6 μ. The writers find them 10–15 × 4–6 μ in the type of *D. Leandrae* and 8–15 × 5–7 μ in type of *D. Miconiae*. The spores are slightly narrower in the former, but this difference is not significant when one considers the great variation in spore measurements in *Bagnisiopsis*.

MATERIAL EXAMINED

Brazil: On *Leandra cordifolia*, sub *Auerswaldia Leandrae* Sydow: Rio Grande do Sul, 1897, leg. Reineck, Type; Sao Francisco, June 1885, Ule *422*: On *Miconia* sp., Sub *A. Miconiae* P. Henn., Amazonas, Rio Jurua, Aug. 1901, Ule *27*, Appen. Mycoth. Brazil; duplicate, Ule, Mus. Bot. Berol, Type. Theissen herb. at Harvard.

2. BAGNISIOPSIS TIJUCENSIS Theiss. & Sydow, Ann. Myc. **13**: 291. 1915.

? *Phyllachora gibbosa* Wint. Rev. Myc. 7: 207. 1885.

? *Phyllachora Sellowii* P. Henn. Engl. Bot. Jahrb. **17**: 525. 1893.

Phyllachora peribebuyensis Speg. var. bullosa Rehm, Hedwigia **35**: 368. 1897.

Haplostroma depressum Sydow, Ann. Myc. **14**: 80. 1916.

Bagnisiopsis depressa Sydow, ap. Theissen. Ann. Myc. **14**: 435. 1916.

Bagnisiopsis Sellowii (P. Henn.) Petrak, Hedwigia **68**: 269. 1928.

Bagnisiopsis gibbosa (Wint.) Petrak, Hedwigia **68**: 271. 1928.

Bagnisiopsis bullosa (Rehm) Petrak, Hedwigia **68**: 283. 1928.

Bagnisiopsis lata Sydow, Ann. Myc. **28**: 109. 1930.

Dothidina Parisi Chardon, Myc. Explor. Ven., Monogr. Univ. of Puerto Rico, ser. B. **2**: 139. 1934.

Type: Rehm Ascom. *1542*, in Theissen herb. at Harvard.

Stromata hypophyllous, isolated or in groups, separated or coalesced, in small irregular yellow to dark brown spots visible from both sides of the leaf, erumpent and at maturity superficial but connected with a hypostroma in the mesophyll, black, varying in shape from orbicular and concave with a definite border to hemispherical or even conical, .3–1.5 mm. in diam., and .3–.5 mm. high; surface entire to very irregular, smooth to verrucose; locules one to many, completely immersed, rarely projecting, with no special wall, 250–300 μ in diam., with conical ostioles rarely visible on the surface; asci cylindrical with long attenuated stalks, p. sp. 76–125 $\times$ 9.5–13 μ and stalk 75–100 μ in length; ascospores 8, uniseriate or obliquely so, continuous, hyaline to brown with age, broadly elliptical with rounded ends or almost spherical, 11.4–17 $\times$ 7.6–12 μ, chiefly 15 $\times$ 9 μ, occasionally up to 19 μ in length; paraphysoids filiform, somewhat branched, numerous, persistent.

Conidia borne in cavities in pulvinate stromata resembling those bearing asci, filiform, hyaline, curved, 15–27 $\times$ 1–1.2 μ.

Hosts: *Blakea* sp., *Miconia flammea*, *M. lepidota*, *M. marcophylla*, *M. ulmarioides*, *Miconia* sp., *Tibouchina longifolia*, *T. multiceps*, *T. paniculata*, *Tibouchina* sp., Melastomaceae.

Distribution: Brazil, Colombia, Dominican Republic, and Venezuela.

The stromata in the type are fairly smooth, and vary from concave to flat to spherical (FIG. 5). Some are very small containing only one locule, while others are large with from 5 to 10 or even more. No characters have been discovered in this species that will separate it from *B. peribebuyensis* except the smaller and proportionately broader spores. Many of the latter in the type are almost globose.

Theissen and Sydow (**11**) give spore dimensions as 13–16 × 6–8 μ and Petrak (**5**) 11–17.5 × 6–8 μ, but the writers find the mature ones of the type much wider, many up to 12 μ in width.

Phyllachora gibbosa, *P. Sellowii*, and *P. peribebuyensis* var. *bullosa* are listed by Theissen and Sydow (**11**) as synonyms under *B. peribebuyensis*. Petrak (**5**) on the other hand has these names in his monograph as three separate species.

The Winter type of *P. gibbosa* was not studied, but the specimens, Ule *230* and *681*, and Puttemans *174* cited below, are identified as that species by Petrak, and they are fully equal to the type of *B. tijucensis*.

There are two packets in the Theissen herbarium, nos. *665* and *666*, both determined as *P. gibbosa* by Rehm, and on both is written by Theissen, equals *B. peribebuyensis*. The no. *665* is a mixture of various Melastomaceae leaves and most of them are infected with *B. peribebuyensis*, while no. *666* is certainly *B. tijucensis*. The writers then, chiefly on Petrak's description, place this name under *B. tijucensis* with a question mark.

Phyllachora Sellowii is also placed here with some hesitation. The type has been studied, but the spores are very immature and plasmolized, and are about 12–18 × 7–9 μ, and if further advanced could very well be either *B. tijucensis* or *B. peribebuyensis*. Petrak (**5**) cites the spores as 10–14 × 4.5–7 μ, which are much smaller than the writers' measurements.

The name *P. peribebuyensis* var. *bullosa* is based on Ule *1848*. Petrak (**5**) raises the variety to specific rank with spores 11–17 × 6–8 μ. This seems fully equal to the type of *B. tijucensis*.

Sydow describes *B. lata* with spores 11–15 × 8–12 μ and *B. depressa* with ones 14–16 × 8–10 μ, which come within the concept of *B. tijucensis*. Also, *D. Parisi* has spores within this range. None of these have distinctive characters of the stroma.

MATERIAL EXAMINED

Brazil. On *Tibouchina* sp., Rehm Ascom. *1542*, sub. *B. tijucensis*, Rio de Janeiro, June 11, 1902, *P. Dusen*, Type; Puttemans *174* sub *B. tijucensis*, Sao Paulo, Mar. 29, 1901; on *T. multiceps*, E. Ule *230*, sub *B. peribebuyensis*, San Francisco, Dec. 1883; on *T. paniculata*, Ule *681*, sub *B. tijucensis*, Rio de Janeiro, Aug. 1887. Theissen herb. at Harvard.

On *Miconia* sp., Ule *1848*, sub *Phyllachora peribebuyensis* = *B. peribebuyensis* var. *bullosa* Rehm, Ouro Preto, Jan. 1892; on *Miconia flammea*, Ule *180*, sub. *B. tijucensis*, San Francisco; on *Miconia lepidota*, Sellow, Berol. herb., sub *P. Sellowii*, on Melastomaceae, Theiss. *666*, sub. *B. gibbosa*, Sao Leopoldo, 1908, det. Rehm. Theissen herb. at Harvard.

Colombia. On *Miconia macrophylla*, Chardon & Nolla *195*. sub *Dothidina scabrosa*, Barro Colorado Isl., Apr. 29, 1929. Cornell herb.

On *Tibouchina longifolia*, Toro *264*, sub *B. tijucensis*, Guarnes, Nov. 3, 1927, and Toro *256*, sub *B. tijucensis*, Titirihi, Aug. 8, 1927. Chardon herb.

Dominican Republic. On *Miconia* sp., Chardon *873*, sub *B. peribebuyensis*, Puerto Plata, July 11, 1937. Cornell herb.

Venezuela. On *Blakea* sp., Sydow Fungi Ven. *349*, sub *B. lata*, Colonia Tovar, Aragua, Jan. 19, 1928, Type. Harvard herb. and U. S. D. A. Myc. Coll.

On *Miconia ulmarioides*, R. Alamo *147*, sub *Dothidina Parisi*, El Cedral nr. Los Teques, Miranda, Jan. 7, 1932; Chardon, Toro & Alamo *305*, sub *D. Parisi*, El Cedral, June 26, 1932; Chardon & Toro *532*, sub *D. Parisi*, Miranda, July 11, 1932, Type; Chardon & Guiscafré *578*, sub *D. Parisi*, Knoop's Park, Los Teques, July 13, 1932; Muller 1900, sub *B. tijucensis*, Petare, May 14, 1937; above in Cornell herb. Chardon *2528*, sub *D. Parisi*, Miranda, Apr. 3, 1938, Chardon herb. F. Tamayo *3897*, sub *Bagnisiopsis* sp., Sebastopol, Miranda, Mar. 1, 1940. Cornell herb.

On *Miconia* sp. Whetzel & Muller *2843*, sub *B. tijucensis*, Tucupe near Caracas, Feb. 28, 1939; Whetzel, Muller & Tamayo *3034*, sub *B. tijucensis*, Caracas a Colonia Tovar, Mar. 19, 1939; Chardon *3141*, sub *B. tijucensis*, Aragua, Mar. 25, 1939; Whetzel & Chardon *3179*, sub *B. tijucensis*, Aragua, Mar. 26, 1939; Whetzel, Muller & Chardon *3207*, sub *B. tijucensis*, Aragua, Mar. 29, 1939; Tamayo *3447*, sub *B. tijucensis*, Miranda, Apr. 19, 1937; above in Cornell herb.

3. BAGNISIOPSIS PERIBEBUYENSIS (Speg.) Theiss. & Sydow, Ann. Myc. **13**: 292. 1915.

Phyllachora peribebuyensis Speg. Anal. Soc. Ci. Argent. **19**: 244. 1886.

Auerswaldia Fiebrigii P. Henn. Hedwigia **43**: 148. 1904.

Dothidina Fiebrigii (P. Henn.) Theiss. & Sydow, Ann. Myc. **13**: 303. 1915.

Dothidina peribebuyensis (Speg.) Chardon, Mycologia **13**: 289. 1921.

Dothidina scabrosa Sydow, Ann. Myc. **23**: 384. 1925.

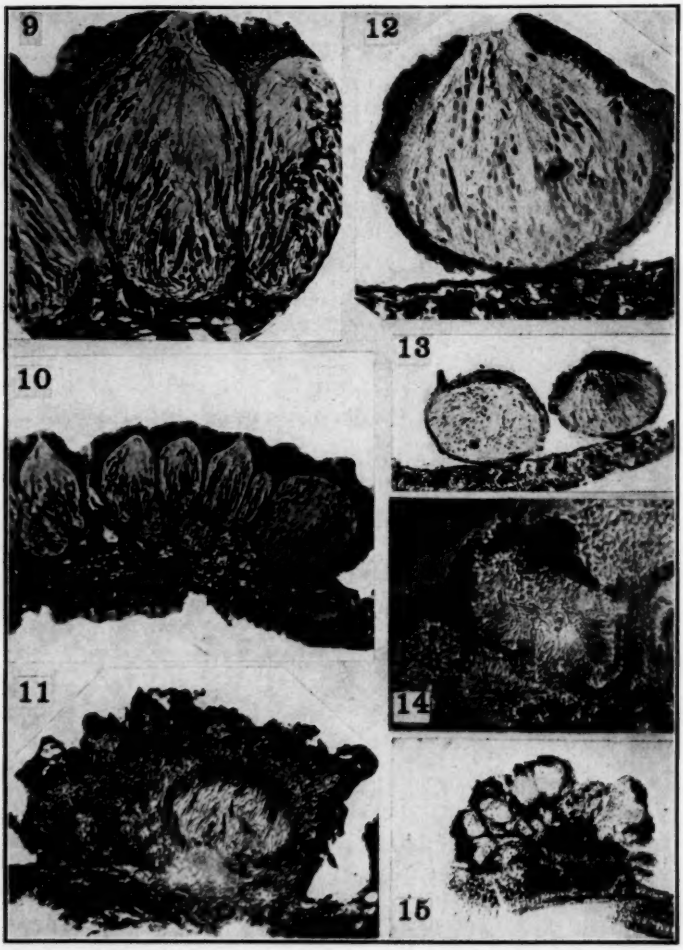
Bagnisiopsis scabrosa (Sydow) Petrak, Hedwigia **68**: 281. 1928.

Bagnisiopsis tovarensis Sydow, Ann. Myc. **28**: 111. 1930.

Hemidothis Pittierii Sydow, Ann. Myc. **28**: 193. 1930.

Type: B. Balansa *3894*. Part is in Speg. herb. and part in Theissen herb. at Harvard.

Stromata hypophyllous, isolated or in small groups, compacted or coalesced, in orbicular discolored spots surrounding the group or separate under each stroma, with hypostroma in mesophyll, erumpent, and superficial at maturity, very variable in form, orbicular with applanate surface, with raised border or not, or almost globose, smooth, or roughened and scabrous, .2–1.5 mm. in diam., and .2–.4 mm. high, black, hard-leathery when dry and almost gelatinous when wet; locules globose to slightly elongate, 250–340 μ in diam., one to many in stroma, immersed, rarely projecting, with conical ostioles rarely apparent on surface of stroma; asci cylindrical, stalked, 100–133 $\times$ 12–19 μ p. sp., with stipe 70–95 μ in length, and much attenuated; ascospores 8, uniseriate or obliquely so, continuous, hyaline, finally brown, broadly elliptical with obtuse ends, 13.3–24 $\times$ 7.6–12 μ, chiefly 19 $\times$ 10 μ at maturity, with epispore uniform, .5 μ wide; paraphysoids filiform, somewhat branched, persistent.



FIGS. 9–15. Photomicrographs of longitudinal sections of *Bagnisiopsis* stromata. 9, *B. tijucensis*, Muller no. *1900*, showing locule with paraphysoids and no special wall, × 263; 10, same section showing the compound stroma of *Bagnisiopsis*, × 83; 11, *B. Toledoi*, Whetzel and Muller no. *2841*, showing young locule and spermagonia on surface of stroma, × 242; 12–13, *B. amadelpha*, Chardon no. *2642;* 12, showing single locule stroma, × 222; 13, showing seta-like process on left side of stroma, × 83; 14–15, *B. peribebuyensis*, Chardon no. *1055*, showing sections through conidial stroma; 14, single cavity with spores, × 263; 15, section of entire conidial stroma, × 45.

Hosts: *Miconia ambigua*, *M. argentea*, *M. Beurlingii*, *M. Candolleana*, *M. laevigata*, *M. prasina*, *Miconia* sp., *Monochaetum hirtum*, *Tetrazygia elaeagnoides*, and other unidentified Melastomaceae.

Distribution: Brazil, Costa Rica, Dominican Republic, Guatemala, Panama, Paraguay, Puerto Rico, and Venezuela.

The stromata in the type are circular, smooth and applanate, to slightly concave, with several locules and spores chiefly 19 × 10 μ. In looking over the mass of material cited below there are leaves with exactly the same shape stromata as on the small piece of the type (FIG. 4) and often on the same leaf there will be every other shape described for the genus. In fact there does not seem to be any form of stroma constant enough to describe for either this species or *B. tijucensis*. Even when there is only a single locule it is never in the form of a symmetrical flasked-shaped perithecium.

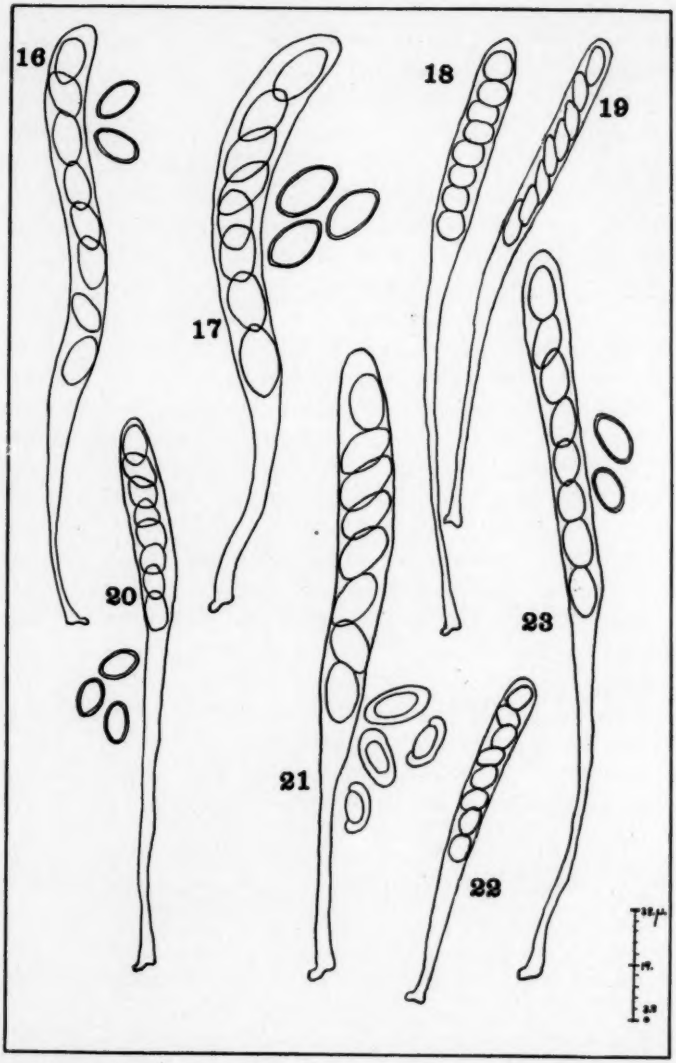
Theissen and Sydow (**11**) give spores of *B. peribebuyensis* as 11–15.5 × 8–10 μ, Saccardo (**7**) as 15–18 × 6–8 μ and Petrak (**5**) as 14–20 × 6–9 μ. Chardon (**2**) examined the Spegazzini type and finds the spores much larger, 18–24.5 × 9–11 μ. This is approximately the same as measurements of the writers for mature spores. Chardon (**1**) also noticed that some of the spores in the type were brown and placed this species in *Dothidina*.

The conidia are filiform, hyaline, curved, 15–26 × 1–1.2 μ, borne in labrinthiform cavities of a stroma similar in all respects to that of the ascigerous stage.

Sydow (**9**) describes *Hemidothis Pittierii* on *Miconia ambigua* as the conidial stage of *B. tijucensis*. His Ascomycete specimen, *163*, that he named with the *Hemidothis* has been studied by the writers and they find large spores typical of *B. peribebuyensis*. Sydow's conidial name then belongs with the latter species.

Sydow (**10**) earlier describes a *Hemidothis Miconiae* on an unidentified *Miconia* species. It would be impossible to connect this name with any *Bagnisiopsis* species as the description would include any of the conidial stages of this genus.

Petrak (**5**) places *D. Fiebrigii* under *B. peribebuyensis* as in this paper. The stromata in the type are applanate-orbicular and the spores are approximately the same as in the type of *B. peribebuyensis*.



FIGS. 16–22. Camera lucida drawings of asci and ascospores of *Bagnisiopsis*, × 789. 16, *B. tijucensis*, Rehm Ascom. no. *1542*, type; 17, *B. peribebuyensis*, Balansa no. *3894*, type; 18, *B. sphaerospora*, Toro no. *314*, type; 19, *B. Leandrae*, Reineck spec. type; 20, *B. Toledoi*, Chardon and Guiscafre no. *565*, type; 21, *B. amadelpha*, Chardon and Nolla no. *443;* 22, *B. minuta*, Sydow no. *272*, type; 23, *B. translucens*, Whetzel and Muller no. *3010*, type.

The Sydow specimen *147*, cited below sub *Dothidina Fiebrigii*, has been studied and the Harvard packet contains only immature stromata barely erumpent.

The type of *D. scabrosa* consists of very small stromata in compact groups in the thick white hairs of *Miconia argentea*. They appear distinctive, but there are similar groups on smooth *Miconia* leaves that fall within the concept of *B. peribebuyensis*.

The other Sydow name placed here, *B. tovarensis*, according to his *833*, has the large spores of this species.

MATERIAL EXAMINED

Brazil. On Melastomaceae, B. Balansa *3894*, sub *Phyllachora peribebuyensis*, Peribebuy, Type, Theissen herb. at Harvard; Balansa *3479*, sub *P. peribebuyensis*, Peribebuy, Chardon herb.; Theissen *665*, sub *P. gibbosa*, Rio de Janeiro, Sept. 1908, det. as *B. peribebuyensis* by Theiss. & Syd., Harvard herb.; on *Miconia Candolleana*, E. Ule *1297*, sub *B. peribebuyensis*, Feb. 1888, Theissen herb. at Harvard; Muller *508*, sub *B. tijucensis*, Minas Geraes, April 29, 1933, Cornell herb.; Muller *606*, sub *D. Parisi*, Minas Geraes, June 8, 1933, Chardon herb.: on *Miconia* sp., Ule *2050*, sub *B. peribebuyensis* var. *bullosa*, Tijuca, Apr. 1893, Theiss. herb. at Harvard; Maublanc *844*, sub *B. peribebuyensis*, Minas Geraes, June 9, 1913, Chardon herb.

Costa Rica. On *Miconia argentea*, Sydow, Fungi Exot. Exsicc. *672*, sub *D. scabrosa*, Alajuela, Oct. 1, 1925, N. Y. B. G. herb.; On *Miconia Beurlingii*, Sydow *147*, sub *D. Fiebrigii*, Feb. 3, 1925, Harvard herb.

Dominican Republic. On *Miconia prasina*, sub *B. peribebuyensis*, Chardon *554*, Trujillo, June 20, 1937; 707, Samana, July 5, 1937; *1055*, La Vega, Aug. 13, 1937; Cornell herb.

Guatemala. On *Miconia argentea*, W. A. Kellerman *6102*, sub *D. scabrosa*, between Patwlal and San Lucas, June 26, 1907, Chardon herb.

Panama. On *Miconia* sp., F. L. Stevens, sub *B. peribebuyensis*, *1072* and *1096*, Tamboa, Aug. 16, 1923; *1317*, Chargres, Aug. 23, 1923; *1326*, France Field, Aug. 24, 1923; *1347*, Gatun, Aug. 24, 1923; Harvard herb.

Paraguay. On Melastomaceae, Balansa *3854*, sub *P. peribebuyensis*, Carapegua, June 24, 1883, det. Speg.; C. Roum. Fung. Gall. Exsicc. *3242*; Chardon herb.: on *Miconia* sp., sub *Auerswaldia Fiebrigii* P. Henn., Type, Theissen herb. at Harvard.

Puerto Rico. On *Miconia* sp., Stevens *840*, sub *D. peribebuyensis*, Consumo, Nov. 27, 1913; Whetzel, Kern & Toro, sub *D. peribebuyensis*, *2505*, on *Miconia laevigata*, Yanco, Finca Maria, June 17, 1924; *2491*, on *Miconia prasina*, Guaynabo, June 11, 1924, and *2602*, Guaynabo, July 3, 1924, N. Y. B. G. and Cornell herbs.

On *Tetrazygia elaeagnoides*, Whetzel, Kern & Toro *2579*, sub *D. peribebuyensis*, Vega Beja, June 27, 1924, N. Y. B. G. herb. and Cornell herb.

Venezuela. On *Miconia ambigua*, Sydow *163*, sub *B. tijucensis* Les Varanjis, Jan. 3, 1928, Harvard herb.

On *Monochaetum hirtum*, Sydow *833*, sub *B. tovarensis*, Colonia Tovar, Aragua, Nov. 1, 1928, Type, Harvard and N. Y. B. G. herbs.

4. **Bagnisiopsis sphaerospora** (Chardon) comb. nov.

Dothidina sphaerospora Chardon, Jour. Dept. Agri. Puerto Rico **13**: 7. 1929.

Type: Toro *314*, Chardon herb.

Stromata hypophyllous, chiefly in coalesced glomerules, 2–3 mm. in diam., with single stromata .2–1 mm. in diam., in indistinct spots, black, cupulate with depressed centers or convex, or flattened hemispherical, erumpent then superficial; locules globose or irregular through lateral pressure, 300–400 × 250–300 μ, with no special wall; asci cylindrical, p. sp. 50–76 × 10–12 μ with attenuated stipes, 76–125 μ in length; spores 8, uniseriate, continuous, globose, or nearly so, 7.6–11.4 μ in diam., chiefly 8.93 × 8.17 μ, hyaline, later light brown, with epispore .5 μ thick; paraphysoids numerous, filiform.

No conidia were found in this specimen.

Hosts: *Clidemia impetiolaris*.

Distribution: Known only from the type locality in Colombia.

This species is near *B. tijucensis*, but differs from this and the other species in having most of the spores globose. The compact masses of stromata are typical of this one specimen, but it is

probable that the distribution would be more variable if many collections were studied.

The transfer to *Bagnisiopsis* is made because *Dothidina* has previously been shown to be synonymous.

MATERIAL EXAMINED

Colombia. On *Clidemia impetiolaris*, Toro *314*, sub *Dothidina sphaerospora*, Medellin, Jan. 20, 1928, Type. Chardon herb.

5. BAGNISIOPSIS TOLEDOI Chardon, Myc. Explor. Ven., Monogr. Univ. of Puerto Rico, ser. B. **2**: 137. 1934.

Type: Chardon & Guiscafré, Myc. Explor. Ven. *565*. Cornell herb.

Stromata hypophyllous, isolated or in groups, separated or coalesced in masses, in small spots, erumpent and superficial at maturity, sessile, constricted underneath and attached to a hypostroma in mesophyll, orbicular and applanate on top or hemispherical or almost globose, .2–1.5 mm. in diam., compact groups sometimes up to 3 mm. in diam., black, with smooth or roughened surface, with prominent black, seta-like processes, cylindrical to conical, sometimes dilated at the apices, 20–50 μ high and 10–20 μ in diam.; locules 1–15 in each stroma, globose to irregular, 200–285 × 143–230 μ, with no distinct wall, with conical ostiole immersed in stroma; asci cylindrical, p. sp. 58–83.6 × 10–14 μ with long attenuate stalks, 80–110 μ in length; spores 8, uniseriate, occasionally turned cross-wise, continuous, hyaline becoming light brown at maturity, broadly elliptical, 7.6–16 × 7.6–11.4 μ, chiefly 12 × 8 μ, with epispore uniform, .5 μ thick; paraphysoids filiform, numerous, somewhat branched.

No conidia were observed.

Hosts: *Clidemia Fendleri*, *Heterotrichum cymosum*, *Miconia grandifolia*, *M. laevigata*, *M. macrophylla*, *M. prasina*, and *Miconia* sp.

Distribution: Puerto Rico, Venezuela.

This species is similar in most respects to *B. amadelpha*, differing in the possession of smaller spores, which do not have the apical and lateral thickening of the wall. Both have the black conoid processes growing from the stromal surface. The dark crust distinguishes them from *B. minuta* and *B. translucens*.

Chardon (**2**) did not describe the surface projections in his original description.

MATERIAL EXAMINED

Puerto Rico. On *Heterotrichum cymosum*, Whetzel, Kern & Toro *2499*, sub *D. peribebuyensis*, Yanco, June 17, 1924, N. Y. B. G. and Cornell Herbs.

On *Miconia laevigata*, Whetzel, Kern & Toro *2606*, sub *D. peribebuyensis*, Maricao, July 6, 1924. N. Y. B. G. and Cornell herbs.

Venezuela. On *Clidemia Fendleri*, Chardon & Stelling *841*, sub *B. Toledoi*, Carabobo, Aug. 7, 1932. Cornell herb.

On *Miconia grandifolia*, Muller *1899*, sub *B. peribebuyensis*, Petare, May 14, 1937; on *Miconia macrophylla;* Chardon & Guiscafré *565*, sub *B. Toledoi*, Los Teques, Miranda, July 13, 1932, Type, and Chardon *1219*, sub *B. Toledoi*, La Granja, Tachira, Sept. 14, 1932; Tamayo and Chardon *3407*, sub *B. peribebuyensis*, Los Teques, Apr. 16, 1939; on *Miconia prasina*, Chardon *2632*, sub *B. peribebuyensis*, Aragua, Apr. 30, 1938; On *Miconia* sp.; Whetzel & Muller *2841*, sub *B. peribebuyensis*, Tecupe, Feb. 28, 1938; Whetzel & Muller *3097*, sub *B. peribebuyensis*, Miranda, Apr. 13, 1939; Whetzel & Muller *3394*, sub *B. tijucensis*, Miranda, Apr. 13, 1939. Above in Cornell herb.

6. BAGNISIOPSIS AMADELPHA (Syd.) Petrak, Hedwigia **68**: 280. 1928.

Dothidina amadelpha Sydow, Ann. Myc. **23**: 387. 1925.

Type: Sydow *149*, on *Miconia furfuracea*, Costa Rica, in Sydow Herb.

Stromata hypophyllous, sparsely scattered or in small groups in orbicular, yellow to brown spots, 1–6 mm. in diam., chiefly evident in the epiphyll, with hypostroma in mesophyll, 100–150 μ in diam., erumpent to superficial at maturity, semiglobose to depressed disciform, 200–700 μ in diam., with surface smooth and regular, black, hard coriaceous when dry, soft fleshy when wet, with conoid dispersed setae-like processes on sides and top, more or less dilated at apices, 20 to 50 μ high and 10–20 μ wide in the middle; locules usually solitary or 2–4 in the stroma, with no special wall, with conical ostioles entirely immersed; asci cylindrical with apices rounded, with long attenuated stipes; 8 spored, p. sp. 78–130 $\times$ 12–17 μ, with stipe 50–80 μ in length; spores uniseriate or obliquely uniseriate, continuous, oblong-ellipsoid to broadly ovate, hyaline, becoming dilute to dark brown with age,

11.4–22.8 × 7.6–11.4 μ, chiefly 18 × 9 μ, with epispore .5 μ wide, but 1.5–2 μ thick at apices and on one side; paraphysoids filiform, somewhat branched, numerous.

No conidia observed.

Hosts: *Tibouchina* sp., *Miconia furfuracea*, *Miconia* sp., and *Clidemia grandifolia*.

Distribution: Colombia, Costa Rica, and Venezuela.

The type of this species has not been distributed in America, and so the writers did not have access to it, but unhesitatingly place the following collections here on Sydow's description.

When considered together there are three distinctive characters; the stroma of more constantly regular shape than in other species, the presence of the short projections, and the large spores with ends and one side thickened. The processes, as Sydow names them, are black and carbonous on the surface with an interior composed of very delicate hyaline hyphae with many nuclei. In cross section they have the appearance of elongate pycnidia parasitizing the stroma.

The ascospores are variable, but average somewhat larger in these specimens than the 12–18 × 7.5–9 μ given by Sydow.

MATERIAL EXAMINED

Colombia: On *Miconia* sp., Chardon and Nolla *443*, sub *D. peribebuyensis*, El Valle, June 9, 1929, Cornell herb.

On *Tibouchina* sp., Chardon *249*, sub *P. peribebuyensis*, Medellin, August 10, 1926, det. Sydow. Chardon herb.

Venezuela: On *Clidemia grandifolia*, Chardon *2642* and *2643*, sub *B. peribebuyensis*, Aragua, April 30, 1938, Chardon and Cornell herb.

7. **Bagnisiopsis minuta** (Sydow) comb. nov.

Sucinaria minuta Sydow, Ann. Myc. **23**: 363. 1925.

Type: Sydow *272*, Costa Rica.

Stroma dispersed, hypophyllous, in small spots, at first yellowish green, later ochraceous or reddish brown, 1–3 mm. in diam., gelatinous carnose, with orbicular outline, 400–800 μ in diam., pustulate to verruciform, collapsing when dry, 250–300 μ high, with plane or slightly concave surface, rarely convex, erumpent then superficial, with equally dispersed, conical projections about

75 μ high; locules more or less numerous, monostichous, entirely immersed, globose or ovate-globose, or angular 140–200 μ in diam., with truncate-conical ostioles; asci cylindrical, with rounded apices, and attenated stalk about 40 μ in length, 8-spores, p. sp. 66–75 × 9–11 μ; ascospores uniseriate, broadly ovate or elliptical, occasionally globose, with rounded ends, continuous, hyaline later yellowish, 8–10 × 6.5–7.5 μ; paraphysoids numerous, usually simple, filiform about 1–1.5 μ thick.

No conidia observed.

Host: *Miconia Thomasiana.*

Distribution: Known only from type locality in Costa Rica.

The pale brown fleshy stroma distinguishes this species from all others except *B. translucens*, from which it differs in possession of smaller spores.

Sydow (**8**) in his drawing shows a definite wall surrounding each locule, such as one would find in the Hypocreaceae in which he placed *Sucinaria*. The writers fail to see this wall in his specimen.

Petrak (**5**), while demonstrating the relationship of this species with *Bagnisiopsis*, did not actually make the combination. This, along with *B. translucens*, show such close affinities with *B. tijucensis* that it does not seem logical to continue *Sucinaria*, or even create a new section of *Bagnisiopsis*.

MATERIAL EXAMINED

Costa Rica: On *Miconia Thomasiana*, Sydow *272*, Los Angeles de San Ramon, Jan. 30, 1925. Type, U. S. D. A. Myc. Coll.

8. **Bagnisiopsis translucens** sp. nov.

Type: Whetzel and Muller, Ven. Myc. Explor. *3010*, Cornell Herb.

Stromata hypophylla, late dispersa vel raro 2–5 aggregata, in maculis minutis, indistinctis, erumpentia, mox omnino superficialia, ambitu orbicularia, .5–1.5 mm. in diam. et .5 mm. alta, superficie flavo-brunneoli, plana vel leniter convexa, basi leniter contracta, in superiore parte tuberculosa processibus conoideis, 60–80 μ altis et in medio 30–40 μ, contextu dilute flavido gelatinoso; loculi 1–10, monostichi, omnino immersi, globosi vel obtuse angulati, ostiolo conoideo immerso; asci copiosi, cylindricei, longo stipitati, p. sp. 76–130 × 10–12 μ et stipite 90–130 μ longo; sporae 8, monostichae, ellipsoideae vel oblongo-ellipsoideae, utrinque late rotundatae, continuae, hyalinae, tandem dilute brunneolae, 11.4–19 × 7.6–9.5 μ; paraphysoides numerosae, filiformae.

Stromata hypophyllous, broadly dispersed or rarely 2–5 in groups, in small indistinct spots, erumpent, later entirely superficial, with orbicular outline, .5–1.5 μ in diam. and .5 μ high, with yellowish-brown surface, plane or slightly convex with base slightly contracted, tuberculous in the upper part with conoid processes, 60–80 μ high and 30–40 μ through the middle, with context dilute yellowish, gelatinous; locules 1–10, monostichous, entirely immersed, globose or obtusely angular, with conoid immersed ostiole; asci copious, cylindrical, long stipitate, p. sp. 76–130 × 10–12 μ and stalk 90–130 μ in length; spores 8, monostichous, ellipsoid or oblong-ellipsoid, with ends broadly rounded, continuous, hyaline, later dilute brown, 11.4–19 × 7.6–9.5; paraphysoids numerous, filiform.

No conidial stage was found.

Host: *Miconia* sp.

Distribution: Known only from Venezuela.

This species differs from all others studied except *B. minuta*, chiefly in the very light brown, almost translucent wall with the short black warts. The setae in *B. Toledoi* and *B. amadelpha* are somewhat narrower and more cylindrical.

MATERIAL EXAMINED

Venezuela: On *Miconia* sp.: Whetzel and Muller *3010*, sub *B. tijucensis*, Colonia Tovar, near Caracas, Mar. 12, 1939, Type; Barrus and Muller *3652*, sub *Bagnisiopsis* sp., San Antonio de Los Altos, Miranda, Dec. 8, 1939; M. F. Barrus *3736*, sub *Bagnisiopsis* sp., Chirgua, Carabobo, Dec. 16, 1939. Above in Cornell herb.

SPECIES EXCLUDED

9. BAGNISIOPSIS MICONIAE (Duby) Petrak, Hedwigia **68**: 275. 1928.

Sphaeria Miconiae Duby, Mem. Soc. Phys. Hist. Nat. Geneva **7**: 405. 1836. *Tab. 1, fig. 1.*

Physalospora Miconiae (Duby) Sacc. Syll. Fung. **1**: 447. 1882.

Botryosphaeria Miconiae (Duby) Hohnel, Sitz-ber. Akad. Wien. **118**[1]: 836. 1909.

Phyllachora Miconiae (Duby) Sacc. Ann. Myc. **11**: 547., 1913.

Neither Theissen and Sydow nor Petrak saw the Duby type, and the former (**11**) do not place it in their monograph because Duby describes stromata appearing in the epiphyll, while all known ones are in the hypophyll. Petrak (**5**) thinks this Duby statement was a mistake, and after examining Ule no. *3402*, decides it is fully equal to the rest of Duby's description. This specimen is also from Brazil, and is on the same host, *Miconia calvescens*, as the type. Petrak then redescribes the species and gives spores as broadly elliptical to almost spherical, 7.5–11 × 7–8.5 μ. Duby also describes spherical spores.

This amended description by Petrak fits the Chardon *B. sphaerospora* very well, but the writers hesitate to accept his concept in view of the very fragmentary diagnosis of Duby and no available type specimen.

10. BAGNISIOPSIS MELASTOMATUM (Lév.) Petrak, Ann. Myc. **32**: 408. 1934.

Sphaeria melastomatum Lév. Ann. Sci. Nat. III. **3**: 54. 1845.
Laestadia melastomatum (Lév.) Sacc. Syll. Fung. **1**: 428. 1882.
Stigmatea melastomatum (Lév.) Sacc. Add. **1**: XLIII. 1883.
Stigmatula melastomatum (Lév.) Syd. Bull. Herb. Boiss. I. **2**: 78. 1901.

This species was in neither the Theissen and Sydow (**11**) nor Petrak (**5**) monographs. The latter examined the type later and amends the original description. His diagnosis of stromata, and spore measurements, 10–15 × 5–7 μ, agree very well with his earlier description of *B. minutula*, which the writers have under *B. Leandrae*. There is further evidence for this view in his statement that this species differs from *B. tijucensis* in the smaller spores. This is the same as in the case of *B. minutula*. However, as the type of *B. melastomatum* is not available for study the writers hesitate to place it in that position.

11. BAGNISIOPSIS MEXICANA (Sacc.) Petrak, Ann. Myc. **27**: 368. 1929.

Phyllachora mexicana Sacc. Ann. Myc. **11**: 546. 1913.

Theissen and Sydow (**11**) have this species in excluded Phyllachorae, but as a synonym under *P. laurina* Cooke. They think the host is not in the Lauraceae but is a *Miconia*.

Petrak not only places *P. mexicana* in *Bagnisiopsis*, but says Theissen and Sydow were mistaken, and that *P. laurina* is distinct and is a *Bagnisiopsis* near *B. gibbosa*. Saccardo gives spores of *B. mexicana* as 12–14 × 9–11 μ which would place it near *B. tijucensis*. Types of *P. mexicana* and *P. laurina* have not been studied by the writers.

12. BAGNISIOPSIS ORELLANA Sydow, Ann. Myc. **37**: 368. 1939.

Type: Sydow *201*, on *Miconia crocea*, in Equador. Spores are described as 9.5–13.5 × 7–9 μ.

13. BAGNISIOPSIS PUYANA Sydow, Ann. Myc. **37**: 370. 1939.

Type: Sydow *882*, on *Miconia pujana*, in Equador. He gives these spores as 10–15 × 5.7–7.5 μ.

The writers have been unable to locate type specimens of the above two. It appears probable that Sydow never distributed parts of these specimens in the United States. His published diagnoses could fit either *B. tijucensis* or *B. Leandrae*.

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LITERATURE CITED

1. **Chardon, C. E.** Pyrenomycetes of Puerto Rico. Mycologia **13**: 289. 1921.
2. **Chardon, C. E. & R. A. Toro.** Myc. Exp. of Ven. Monog. of Univ. of P. R. B. **2**: 138–9. 1934.
3. **Clements, F. E. & C. L. Shear.** The genera of fungi. pp. 496. The H. W. Wilson Co., N. Y. 1931.
4. **Petrak, F.** Myk. Notizen 595. Über die Gattung *Hemidothis* Syd. Ann. Myc. **25**: 326–328. 1927.
5. **Petrak, F.** Über *Bagnisiopsis* und verwandt Gattung. Hedwigia **68**: 251–290. 1928.
6. **Petrak, F.** Myk. Notigen, 660. Über Höhnels Auffassung der Gattung. *Hemidothis* Syd. Ann. Myc. **27**: 374. 1929.
7. **Saccardo, P. A.** Syll. Fung. **9**: 1017. 1891.
8. **Sydow, H.** Fungi in itinere costaricensi collecti. Ann. Myc. **23**: 308–429. 1925.
9. **Sydow, H.** Fungi venezuelani. Ann. Myc. **28**: 29–224. 1930.
10. **Sydow, H. & P.** Fungi Amazonici a. cl. E. Ule. lecti. Ann. Myc. **14**: 65–97. 1916.
11. **Theissen F. & H. Sydow.** Die Dothideales. Ann. Myc. **13**: 149–746. 1915.

HOST INDEX FOR EUBAGNISIOPSIS

Blakea sp.
B. tijucensis
Clidemia Fendleri
B. Toledoi
Clidemia grandifolia
B. amadelpha
Clidemia impetiolaris
B. sphaerospora
Heterotrichum cymosum
B. Toledoi
Leandra cordifolia
B. Leandrae
Miconia ambigua
B. peribebuyensis
Miconia argentea
B. peribebuyensis
Miconia Beurlingii
B. peribebuyensis
Miconia Candolleana
B. peribebuyensis
Miconia flammea
B. tijucensis
Miconia furfuracea
B. amadelpha
Miconia grandifolia
B. Toledoi
Miconia laevigata
B. peribebuyensis
B. Toledoi
Miconia lepidota
B. tijucensis
Miconia macrophylla
B. tijucensis
B. Toledoi
Miconia Pilgeriana
B. Leandrae
Miconia prasina
B. peribebuyensis
B. Toledoi
Miconia Thomasiana
B. minuta
Miconia ulmarioides
B. tijucensis
Miconia sp.
B. amadelpha
B. peribebuyensis
B. Toledoi
B. translucens
B. tijucensis
Monochaetum hirtum
B. peribebuyensis
Tetrazygia elaeagnoides
B. peribebuyensis
Tibouchina longifolia
B. tijucensis
Tibouchina multiceps
B. tijucensis
Tibouchina paniculata
B. tijucensis
Tibouchina sp.
B. amadelpha
B. tijucensis
Melastomaceae Undet.
B. peribebuyensis
B. tijucensis

THE SPERMODOCHIDIUM, AN UNUSUAL TYPE OF SPERMATIAL FRUIT-BODY IN THE ASCOMYCETES [1]

H. H. Whetzel

In 1851, Tulasne,[2] in a paper on the reproductive apparatus of the Lichens and Fungi, written in French, designated what were then generally regarded as the male organs and male gametes of the Lichens as "*spermogonies*" and "*spermaties*" respectively. In 1852,[3] in a mémoire on the Lichens, he again made use of these terms but gave to them Latin forms—*spermagonia* and *spermatia*.

In 1853, de Bary [4] adopted the terms spermogonia and spermatia for the homologous organs and their products in the Rust Fungi, and he thus followed a suggestion that had been made by Tulasne in 1851.

Finally, in 1861, in his Selecta Fungorum Carpologia,[5] Tulasne extended the application of the terms spermogonia and spermatia to homologous organs in the Pyrenomycetes and other Ascomycetes.

In 1884, in his text-book on the Morphology and Physiology of the Fungi, de Bary followed Tulasne in the general application of the terms spermogonia and spermatia to the Lichens and various groups of the Ascomycetes.

In his discussion of the polymorphic stages in the life-history of certain Sphaeriales, Tulasne [6] distinguished between a spermogonium and a pycnidium, on the basis of the size and power of germination of the cells which are set free in their cavities.

[1] It is with much pleasure that I acknowledge the kindly critical assistance of Dr. A. H. R. Buller in the preparation of this paper.

[2] Comptes Rendus **32**: 470–475, 1851 and Ann. Sci. Nat. III. **15**: 372–373, 1851.

[3] Ann. Sci. Nat. III. **17**: 157, 1852.

[4] Die Brand pilze, p. 59–62. 1853.

[5] P. 57, 181.

[6] Sel. Fung. Carp. **1**: 58, 1861.

A spermogonium is a fruit-body having a hyphal wall from the inner layer of which, on the bottom and sides, arise spermatiophores from the tips of which the spermatia are usually produced in a successive series, thus filling the cavity with a mucilaginous mass of these minute spore-like bodies. Tulasne's descriptions and illustrations of spermogonia in the various species which he investigated emphasize the fact that the walls of a spermogonium are constructed from fungus hyphae.

The spermatial fruit-body of many Discomycetes, as is now known,[7] is not enclosed in a hyphal wall, but takes the form of a naked sporodochium, the spermatiophores arising from a central or basal hyphal-centrum. To this type of spermatial fruit-body I have given the name *spermodochium*.[8]

There is another type of spermatial fruit-body, simulating a spermogonium externally, but internally of a very different construction. This type of spermatial fruit-body is characteristic of those species of *Sclerotinia* that attack certain members of the Cyperaceae and Juncaceae, as for example *S. Duriaeana* Tul., *S. longisclerotialis* Whet., and *S. scirpicola* Rehm. In these species the spermatia are produced within lysigenous cavities in the diseased culms. These cavities, which lie just beneath the epidermis and between the vascular bundles, result from the destruction, by the fungus, of the thin-walled cortical cells. Here, arising on ramifying hyphae, are produced many globose spermodochia which, together with the accumulating mucilaginous mass of spermatia, fill the cavity to bursting. The epidermal covering is eventually ruptured by a slit and the mass of spermatia ooze forth in a sticky, olivaceous drop. Viewed from the exterior, the spermatial fruit-bodies appear as dark-brown or black pycnidia. When fresh or moist, they are swollen or tuberculate. When dry, they appear as narrow brown lines or as minute oval discs, variously distributed along the diseased culms. The dark color of these fruit-bodies is due primarily to the olivaceous-brown color of the massed spermatia and spermatio-

[7] Whetzel, H. H. Mycologia 29: 135. 1937.

[8] Although modern dictionaries validate the spelling of spermogonia and its derivatives with either an *o* or an *a*, the original spelling with the *o* is to be preferred.

phores within. The spermatia and spermatiophores, viewed singly under the microscope, appear to be nearly or quite colorless.

The cavity in which the spermodochia are housed is very different from that of a typical spermogonium. The walls of the cavity enclosing the spermodochia consist of the surrounding *undigested cells of the suscept tissues*. There is no hyphal wall enclosing the massed spermodochia and spermatia. Spermatiophores do not arise from the periphery of the cavity as they do in a true spermogonium. The structure of a cavity enclosing spermodochia, as seen in cross-section, is accurately illustrated for *S. longisclerotialis* in Mycologia **21**: *Fig. 23.*

Since the spermatial fruit-bodies above described are so very different in structure from true spermogonia, they merit a distinctive appellation. I, therefore, propose the name SPERMODOCHIDIUM [9] (pl. *spermodochidia*) to designate a spermatial fruit-body in which spermodochia are housed in a distinctive lysigenous cavity in the tissues of the suscept.

Tulasne [10] appears to have been the first to illustrate the internal structure of the spermodochidium in a species of *Sclerotinia* attacking a *Carex*. He was concerned with the spermatial fruit-body of *S. Duriaeana* in the culms of *Carex brizoides* L. (erroneously, *C. arenaria* L.). It should be noted that he does not refer to this body as a spermogonium, but uses instead the generic name, *Epidocium*. It is evident, however, that he was influenced in his description and in the delineation of his figure 21 by his spermogonial concept, for he speaks of the "fertile walls and loose filaments of the fungus" in describing (p. 186) the cross-section in his illustration. He represents in this drawing a rather indefinite pseudoparenchymatous wall lining the cavity, with a few spermatiophores arising from the wall but, strangely enough, along its upper part only. His details of the structure of the globose spermadochia packed in the cavity are accurately rendered However, he is in error in showing a fungal wall lining the cavity, with spermatiophores arising therefrom. I have carefully studied thin cross-sections of the spermodochidia of *S. Duriaeana*—the

[9] I am indebted to Dr. A. H. R. Buller of the University of Manitoba and Dr. V. M. Cutter of Cornell University for the coinage of this term.

[10] Sel. Fung. Carp. **3**: *pl. 22, fig. 21*, 1865.

same species with which Tulasne worked—and have found no trace of a fungal wall. Tulasne evidently mistook the brown walls and contents of the *Carex* tissues lining the cavity for a fungal pseudoparenchyma. The few spermatiophores which he shows arising from a limited area in this supposed wall may have been detached and misplaced in cutting the section. Thus, in a new situation, may the preconceived concept of a given organ occasionally lead even the most careful and accurate observer into error.

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A NEW NEMATODE-CAPTURING DACTYLELLA AND SEVERAL RELATED HYPHOMYCETES

CHARLES DRECHSLER

(WITH 4 FIGURES)

In two earlier papers (**2**, **3**) descriptive accounts were given of twenty-one interrelated mucedinaceous fungi observed capturing and consuming actively motile eelworms in transparent agar plate cultures planted with softened discolored rootlets or, at times, with various other decaying materials. A twenty-second mucedinaceous fungus of similar predaceous character and having taxonomic kinship in the same intimate series is described herein as a new species. Occasion is taken to describe likewise as new species three hyphomycetous forms which together with a fourth form identified as *Dactylaria pulchra* Linder (**7**) apparently also belong in the series, though so far none of the four have been demonstrated either to capture microscopic animals or to subsist habitually as parasites.

ANOTHER CONSTRICTING DACTYLELLA WITH BROAD BISEPTATE CONIDIA

A maizemeal-agar plate culture that after being permeated with mycelium of *Pythium ultimum* Trow had received on May 13, 1941, some addition of decaying bluegrass leaves taken three days earlier from a heap of lawn clippings in Arlington, Va., revealed on May 27 a sparse array of tall colorless conidiophores, each bearing terminally a single large biseptate colorless conidium of distinctive prolate ellipsoidal shape. In accordance with expectations suggested by their general resemblance to the fertile hyphae more especially of the nematode-capturing species I presented earlier as *Dactylella bembicodes* (**2**) and *D. doedycoides* (**3**), the tall conidiophores were found arising from a mycelium that manifestly was nourished on the fleshy contents of eelworms held fast and strangled by it. During the ensuing two weeks the predaceous mycelium spread throughout the Petri plate culture,

giving rise here and there to additional conidial apparatus in quantity commensurate with the somewhat meager supply of living prey. Since this prolonged development took place at laboratory temperatures ranging between 28° and 32° C.—at temperatures mostly too high for abundant predaceous development of any large-spored *Dactylella* then known to capture eelworms—it was evident that the fungus here concerned differed from familiar allied species in its thermal adaptations as well as in the outward form of its conidia. Pure cultures obtained through removal of the conidia to sterile agar media soon brought to light accessory reproductive bodies expressive of further distinctiveness.

In pure culture on maizemeal agar the fungus grows with moderate rapidity to produce a colorless mycelium composed of branching hyphae divided by cross-walls into segments of moderate lengths. Owing to a somewhat promiscuous arrangement of the hyphae the mycelium in the transparent medium has a dull appearance without the luster usual in mycelia of such species as *Arthrobotrys dactyloides* Drechsl. and *Dactylaria brochopaga* Drechsl. (**2**), both of which extend their filaments in more nearly parallel arrangement. The younger hyphae contain clear homogeneous protoplasm wherein granules of variable size are distributed rather sparingly. During the younger stages of hyphal development, no less than during the later increasingly vacuolate stages, the pore of each septum is guarded on both sides by granules of the type discussed by Buller (**1**: p. 128) as "Woronin bodies." Ordinarily when maizemeal-agar cultures are kept free of alien organisms and protected against mechanical disturbances they show no development of special apparatus for capture of prey.

Nematode-infested agar cultures afford only rather sparse mycelial development of the fungus. Along the straightforward rangy hyphae creeping over the infested substratum, or lying horizontally submerged under its surface, predaceous organs are produced which, as in *Arthrobotrys dactyloides*, *Dactylella bembicodes*, *D. doedycoides*, *Dactylaria brochopaga*, and *Trichothecium polybrochum* Drechsl. (**2**), consist of three-celled constricting rings, each attached by a curving two-celled stalk. Although these

rings commonly originate in positions beneath the parent filament and in planes approximately at right angles to it, they often are jostled by passing nematodes into more nearly horizontal postures, so that their cellular make-up may then conveniently be viewed flatwise (FIG. 1, *A*, *a*, *b*; *B*, *a*, *b*; *C–F*). When a ring is thus viewed the aperture framed by the inner contour of its three arcuate segments is not smoothly circular or smoothly elliptical like the outer contour, but appears in some degree scalloped, owing to the presence of a median thickening on the inner side of each segment. Usually, as in other species, the arcuate segment of distal origin anastomoses somewhat more broadly with the arcuate segment of proximal origin than with the adjacent distal cell of the stalk. The stalk itself most closely resembles that of *D. doedycoides*, being perceptibly longer and slenderer than the homologous part of any of the four other species so far made known as capturing eelworms by means of constricting rings. Naturally the somewhat greater length of the stalk entails no difference in the manner in which the remarkable annular trap closes upon an intruding animal. The three arcuate cells here, just as in the short-stalked species, swell and contract abruptly to hold the hapless animal and at the same time to bring about its disablement promptly, so that the assimilative hyphae may the sooner be extended into its fleshy body. In some instances, especially where the prey is relatively small and weak, subsequent development likewise follows the same course as in the short-stalked forms—the fungus protoplasm elaborated by the assimilative hyphae at the expense of the animal's substance, being transferred to the parent mycelium by way of the stalk (FIG. 1, *G*). However, in other instances, especially where a comparatively large and vigorous captive has been taken, the stalk suffers injury from the animal's struggles. To remedy such injury a new hyphal connection is established. If, for example, the proximal cell of the stalk has been damaged severely enough to require evacuation of its contents, the distal cell may extend a short branch obliquely backward to anastomose with the parent filament (FIG. 1, *H*), thereby opening a new avenue for movement of elaborated protoplasm. If the stalk as a whole has been subject to severe wrenching, a new hyphal connection may be formed to unite the

parent filament with the swollen distal segment of the ring (FIG. 1, *I, a*). It seems probable moreover, that even where the stalk has not been perceptibly damaged an additional hyphal communication is frequently formed merely to furnish a supplementary channel for transfer of the materials elaborated in the expropriation of a large captive. Replacement of an injured stalk, or on occasion, presumably, development of a supplementary connection, occurs likewise in *D. doedycoides;* the published figure of that species showing a ring that after having functioned in the capture of a nematode had established a second connection between its proximal swollen cell and the parent filament (**3**: p. 455, FIG. 1, *H*).

After the mycelium in a nematode-infested culture has been active for some time in destroying prey, it gives rise here and there to erect conidiophores (FIG. 1, *J, a, b; K*) generally similar to those of *Dactylella bembicodes*. They resemble, with respect to stature and septation, also the conidiophores of *D. doedycoides*, but as a rule lack the bulbous apical modification which suggested the epithet of that species. Like the tall conidiophores of *D. doedycoides*, again, they bear large, predominantly biseptate, solitary conidia (FIG. 1, *J, a; L, a–u*), consisting typically of a small basal cell, a large median cell, and a small apical cell. When its primary function has been served, a conidiophore usually falls over on to the substratum, and then often sends up from one or another of its wider basal segments a new conidiophore of similar stature. Occasionally, indeed, an old conidiophore may by lateral branching from a basal segment give rise to a new one even while it is still maintaining a more or less erect posture.

Although the large conidia of the present fungus resemble the homologous spores of *Dactylella doedycoides* with respect to septation, they are distinguished from the latter not only by their generally greater length and lesser diameter, but also by their prolate ellipsoidal rather than broadly turbinate shape. Viewed at an angle perpendicular to its axis, the detached conidium, like that of *D. doedycoides*, presents at its base a sharply truncate outline along the plane of disarticulation. A minute but distinct basal protrusion, absent in *D. doedycoides*, removes the truncate portion of profile from alignment with the main elliptical profile of the spore. After falling on moist agar substratum the de-

tached conidia germinate readily, often putting forth one (FIG. 1, *M*) or two (FIG. 1, *N*) germ tubes from the basal segment, or emitting a germ tube from both the basal and the terminal cell (FIG. 1, *O*). Frequently, again, germination takes place by the production of a germ conidiophore on which is borne a secondary conidium similar to the primary one except in its noticeably smaller dimensions (FIG. 1, *P*).

Erect aerial conidiophores of the same type as those produced sparingly by the fungus in nematode-infested cultures are formed more abundantly in pure cultures prepared with maizemeal agar (FIG. 2, *A*, *B*). Some little tendency toward reduced height is often recognizable here in an increased proportion of moderately short conidiophores. Often, too, the conidiophores formed in pure culture appear less markedly differentiated from mycelial hyphae than in eelworm-infested cultures; the lesser differentiation coming to light in smaller basal diameter, reduced tapering, greater apical width, and more frequent haphazard flexures. This obliteration of structural features ordinarily distinguishing filaments given over to production of the large conidia is even accompanied now and then by loss of the erect aerial habit; for in pure cultures some conidiophores are produced completely submerged under the surface of the maizemeal-agar medium and in positions parallel with this surface. Such intramatrical development of conidiophores has not hitherto been observed in any other member of the predaceous series of hyphomycetes, though several hyphomycetes parasitic on nematodes, including *Harposporium anguillulae* Lohde and the species I described (**4**) under the binomials *H. helicoides*, *H. oxycoracum*, *H. diceraeum*, and *Meria coniospora* readily form their conidia within a soft agar medium, especially in instances where the animal host has succumbed well below the surface.

The large conidia borne intramatrically on submerged hyphae, as also the similar conidia (FIG. 2, *C*, *a–z*) produced in pure culture on the tall erect hyphae, show no marked difference with respect to size, shape, septation, or germination (FIG. 2, *D*, *a*, *b*), from those formed in nematode-infested cultures. In mounts made from actively sporulating cultures, a small proportion of the conidia referable to the type under consideration contain only a

single cross-wall (FIG. 1, *L*, *a*, *b*, *c;* FIG. 2, *C*, *b*, *h*, *q*, *r*, *s*, *w*) which nearly always corresponds in position to the basal cross-wall of the preponderant biseptate specimens. Since, for the most part, absence of a second cross-wall would seem attributable here to immaturity, it was deemed advisable not to include either uniseptate or unseptate specimens of the large conidia in making the measurements utilized in drawing up the diagnosis. The relevant metric data submitted in the diagnosis are thus based wholly on measurements of biseptate specimens, 100 in number, whereof 50 were taken at random from a pure culture, and 50 from a nematode-infested culture. The 100 values for length, expressed to the nearest integral number of microns, are distributable as follows: 35 μ, 1; 36 μ, 6; 37 μ, 9; 38 μ, 10; 39 μ, 12; 40 μ, 20; 41 μ, 17; 42 μ, 10; 43 μ, 6; 44 μ, 5; 45 μ, 2; 46 μ, 1; 47 μ, 1; while the values for width are distributable thus: 13μ, 4; 14 μ, 3; 15 μ, 16; 16 μ, 27; 17 μ, 28; 18 μ, 13; 19 μ, 5; 20 μ, 4.

After development of large conidia is well under way, the fungus in pure culture on maizemeal-agar plates gives rise at the tips of prostrate filaments (FIG. 2, *E*, *a*) and more especially at the tips of short lateral branches (FIG. 2, *E*, *b–e*) borne at intervals on such filaments, to smaller, elongated, somewhat curved, regularly uniseptate conidia (FIG. 2, *F*, *a–z*). The individual filament or branch, having formed one of these smaller conidia, continues development by growing out laterally a short distance below its tip, and on the tip of the spur thus produced forms a second, similarly uniseptate, elongated, curved conidium. With repetition of the process additional conidia are formed, and the sporiferous element is prolonged into a rather crooked, prominently spurred rachis. The elongating rachis soon comes to lie in large part prostrate on the surface of the substratum, although the two or three youngest spurs retain usually an erect or ascending posture, and as a result the young conidia attached to or being produced on them are commonly found extending into the air. Disarticulation evidently takes place very readily, for the mature conidia are mostly found strewn about on the substratum near the denuded rachis from which they came.

Detached conidia of the smaller type are not sharply truncate at the base like the larger conidia, but usually have a profile that

is only a little less smoothly rounded at the proximal end than at the distal end. The single cross-wall dividing them is most often laid down somewhat below the middle, though its insertion in an approximately median position is not infrequent (FIG. 2, *F, a, e, h, s, t, y*). Now and then it is placed slightly above the middle (FIG. 2, *F, c, i*), or, again, so far below the middle that the distal segment may be nearly three times as long as the proximal segment (FIG. 2, *F, v*). Whatever the position of its cross-wall the small conidium germinates without difficulty, often by putting forth a germ tube from the basal end (FIG. 2, *G, a, b*) or from both the basal and the apical end (FIG. 2, *G, c*). Germ tubes of such origin, much like ordinary hyphae, anastomose freely with mycelial filaments (FIG. 2, *G, d*).

The smaller conidia are filled with protoplasm which though often somewhat more granular than the protoplasm of the larger conidia is otherwise apparently of similar character. The contrast of outward shape is therefore not associated here by any pronounced difference in internal organization, such as is evident in *Dactylella doedycoides*, where the elongated conidioid bodies produced sparingly on short erect branches contain numerous globules in curiously distinctive arrangement. Often the contrast in outward shape is impaired to some degree through the occasional production on the tall conidiophores—perhaps, more especially, on germ conidiophores (FIG. 1, *P*)—of rather narrow, straight or curved conidia (FIG. 1, *L, b, d, e;* FIG. 2, *C, x*) intergrading variously with conidia formed on the short prostrate branches. However, the distinction between the two types of spores is here not as badly obscured by intergradation as in *Arthrobotrys dactyloides*, where biseptate swollen conidia, if formed at all, are borne on tall conidiophores of the same kind as those bearing the uniseptate elongated conidia, and, indeed, are often borne promiscuously intermingled in the same head with the uniseptate conidia.

In pure culture on maizemeal agar the fungus also produces, mainly under the surface of the substratum, numerous resting bodies consisting frequently of a simple intercalary chain of ten to twenty inflated hyphal segments filled with globuliferous contents (FIG. 2, *H*). Very often, again, they are more complex in

their makeup and include, in addition to the segments derived by modification of an axial filament, an equal or even larger number of segments derived from proximal portions of several branches (FIG. 2, *I*). Both in simple and in branched resting bodies the median segments are more strongly distended and contain larger globules than the more remote segments, which usually show gradual transition toward the unmodified character of the outlying mycelium. The distended cells have a faintly yellowish coloration, and are provided with walls noticeably thicker than the membranes surrounding ordinary hyphae, though the thickening is not pronounced.

Despite their conspicuously multicellular make-up and only moderate induration the rangy resting bodies appear homologous with the chlamydospores of *Arthrobotrys oligospora* Fres. and of the three allied nematode-capturing species I described (**2**) under the binomials *A. conoides*, *A. musiformis*, and *Dactylaria thaumasia*. These chlamydospores, it is true, are predominantly unicellular, yet cultures of *A. oligospora* sometimes reveal a fairly generous admixture of two-celled specimens, while cultures of *A. conoides* may contain not only a liberal admixture of both two-celled and three-celled specimens, but also occasional specimens composed of four or even five cells. Owing to their thicker walls and deeper yellowish coloration, the chlamydospores of the four species mentioned offer an appearance more strongly suggestive of endurance under unfavorable conditions than is offered by the rangier resting bodies. With respect to desiccation, at least, this hardier appearance may not be unwarranted. Cultures of *A. oligospora*, *A. conoides*, and *D. thaumasia*, which were planted in tubes of maizemeal agar in March 1938, and which fifteen months later were removed from a refrigerator to be kept in the laboratory without protection from evaporation, produced an abundance of new conidia following addition of sterile water in April, 1942, though the agar substratum had then for fully thirty months been in a completely air-dry state, with the hardness and consistency of horn. However *A. musiformis*, tested in parallel cultures with the other forms, failed to revive; so that its chlamydospores would seem to be of somewhat lesser endurance.

As the fungus forming the rangy resting bodies appears not to have been described hitherto, it is presented here as a new species under a name having reference to its production of two kinds of conidia.

Dactylella heterospora sp. nov.

Mycelium effusum; hyphis hyalinis, septatis, plerumque 1.7–5 μ crassis, hic illic ex ramulis bilocularibus vulgo 12–25 μ longis et 2.5–3.5 μ crassis laqueos circulares 20–30 μ latos proferentibus qui in 3 cellulis arcuatis 15–25 μ longis medio 4–5.5 μ extremo 2.5–4 μ crassis consistunt; vermiculo nematoideo in laqueum apertum errato, tribus cellulis arcuatis abrupte se contrahentibus tumentibusque, ita animal captivum magnopere comprimentibus, mox id trucidentibus, integumentum ejus perforantibus, hyphas intus evolventibus quae carnem exhauriunt. Hyphae generis vulgaris fertiles hyalinae, erectae, simplices vel rarenter parvulum ramosae, plerumque 200–500 μ altae, basi 5–8 μ crassae, sursum leviter attenuatae, apice 2–4 μ crassae, conidia singula ferentes, quandoque recrescentes denique 1–2 alia conidia gerentes; his conidiis hyalinis, vulgo speciose ellipsoideis, fere rectis rarius curvatis, basi minute prominulis attamen abrupte truncatis, plerumque 35–47 μ (saepe circa 40 μ) longis, 13–20 (saepe circa 16.5 μ) crassis, biseptatis, loculo infimo 5–10 μ (saepe circa 7.3 μ) longo, loculo medio 21–30 (saepe circa 25.6 μ) longo, loculo summo 5–9.5 μ (saepe circa 7.1 μ) longo. Hyphae generis alterius fertiles hyalinae, saepius solos 15–25 μ longae, basi 2.5–4 μ crassae, sursum 1.5–2 μ crassae, apice singula conidia ferentes, denique identidem subter apicem repullulantes saepe 5–15 alia conidia deinceps gerentes, ita postea vulgo procumbentes vel ascendentes, irregulariter geniculatae, aliquot ramulis 1–10 μ longis instructae; conidiis hic abjunctis hyalinis, cylindraceis, utrimque rotundatis, plerumque curvatis vel allantoideis, 23–40 μ (saepe circa 31.3 μ) longis, 5.3–8 μ (saepe circa 6.8 μ) crassis, uniseptatis, loculo infero 7.5–17.5 μ (saepe circa 12.7 μ) longo, loculo supero 12–26 μ (saepe circa 18.6 μ) longo. Corpora perdurantia intra matricem orta, flavida, protoplasmatis valde guttulosi repleta, saepius intercalaria, modo simplicia, moniliformia, 100–250 μ longa, in 10–20 cellulis consistentia, modo ramosa denique ex 15–45 cellulis constantia; cellulis in medio corporis saepe 15–30 μ longis et 15–20 μ crassis, eis ad extremos angustioribus gradatim in hyphas mycelii transeuntibus.

Plectum parvum et alios vermiculos nematodeos capiens consumensque habitat in foliis Poae pratensis putrescentibus in Arlington, Virginia.

Mycelium spreading; vegetative hyphae hyaline, septate, 1.7 to 5 μ wide, often especially in presence of nematodes producing mostly underneath and in perpendicular positions approximately circular rings 20 to 30 μ in outside diameter, composed individually of 3 arcuate cells 15 to 25 μ long, 4 to 5.5 μ wide in the middle and 2.5 to 4 μ wide at the ends—the first and third of the cells being united to each other as well as to the distal end of a somewhat curved, 2-celled supporting stalk 12 to 25 μ long and 2.5 to 3.5 μ wide; following ensnarement of a nematode, the individual

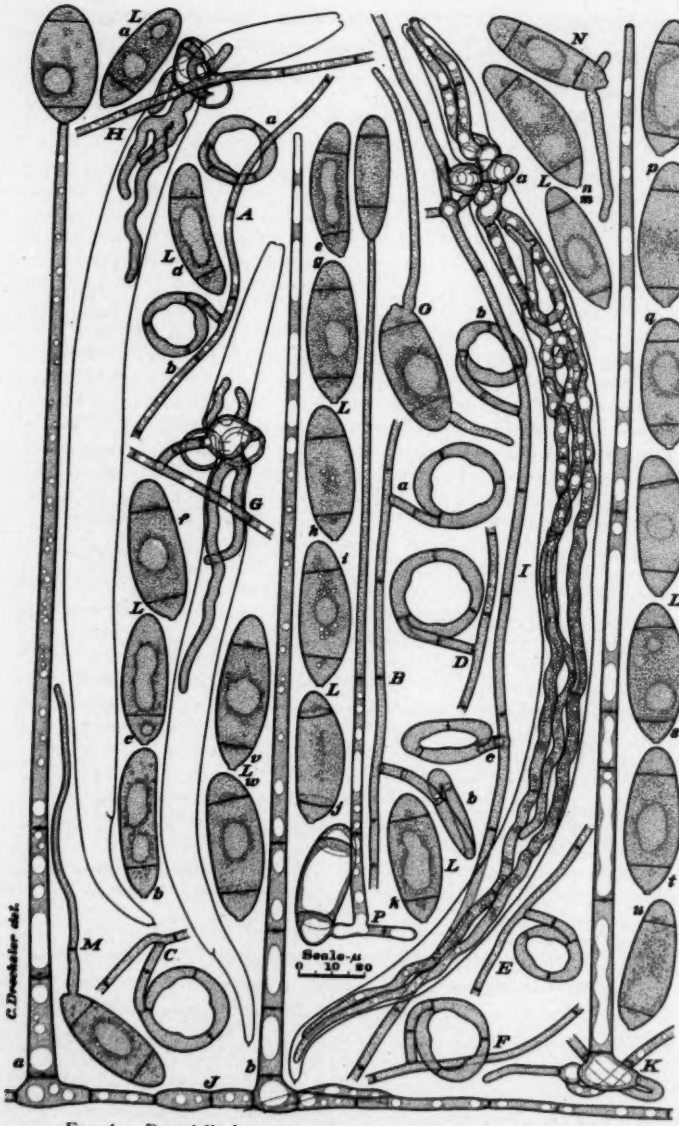

FIG. 1. *Dactylella heterospora* from nematode-infested cultures.

ring through inflation and contraction of the 3 arcuate cells constricting the animal to death or disabling it, then perforating the integument and extending lengthwise through the body assimilative hyphae that appropriate the fleshy contents. Conidiophores of the taller and more frequent type hyaline, erect, usually simple but occasionally branched, mostly 200 to 500 μ high, 5 to 8 μ wide at the base, tapering gradually upward, 2 to 4 μ wide at the apex, there bearing a single conidium, and sometimes, following repeated elongation, 1 or 2 additional conidia; the conidia thus produced being mostly handsomely prolate ellipsoidal, slightly protuberant at the abruptly truncate base, 35 to 47 μ (average 40 μ) long, 13 to 20 μ (average 16.5 μ) wide, divided by 2 cross-walls into 3 cells, the basal cell measuring 5 to 10 μ (average 7.3 μ) in length, the middle cell 21 to 30 μ (average 25.6 μ), and the apical cell 5 to 9.5 μ (average 7.1 μ). Conidiophores of the smaller type hyaline, often only 15 to 25 μ long, 2.5 to 4 μ wide at the base, 1.5 to 2 μ wide at the tip, after production of one conidium growing out repeatedly somewhat below the apices of successive spurs to abjoint often 5 to 15 additional conidia one after another, and thereby forming a strongly geniculate rachiform prolongation, often bearing several branches 1 to 10 μ long; the conidia abjointed here being hyaline, cylindrical with rounded ends, mostly curved and somewhat allantoid, 23 to 40 μ (average 31.3 μ) long, 5.3–8 μ (average 6.8 μ) wide, divided by a single cross-wall into a basal cell 7.5 to 17.5 μ (average 12.7 μ) long and a distal cell 12 to 26 μ (average 18.6 μ) long. Resting bodies regularly formed in the substratum, yellowish, filled with pronouncedly globuliferous protoplasm, most often intercalary, sometimes unbranched, moniliform, 100 to 250 μ long and composed of 10 to 20 cells, at other times branched and then often consisting of 15 to 45 cells; the median cells often 15 to 30 μ long and 15 to 20 μ wide, those at the ends narrower and gradually intergrading with contiguous unmodified mycelial segments.

Capturing and consuming *Plectus parvus* Bastian and various other nematodes it occurs in decaying leaves of *Poa pratensis* L. in Arlington, Va.

DACTYLARIA PULCHRA Linder

In an assortment of fungus cultures received from Dr. M. B. Linford late in 1937 and for the most part representing nematode-capturing hyphomycetes isolated by him from Hawaiian soils (**8**) was included a mucedinaceous form which he considered comparable biologically with my *Dactylella tenuis* (**2**: p. 538–539); for

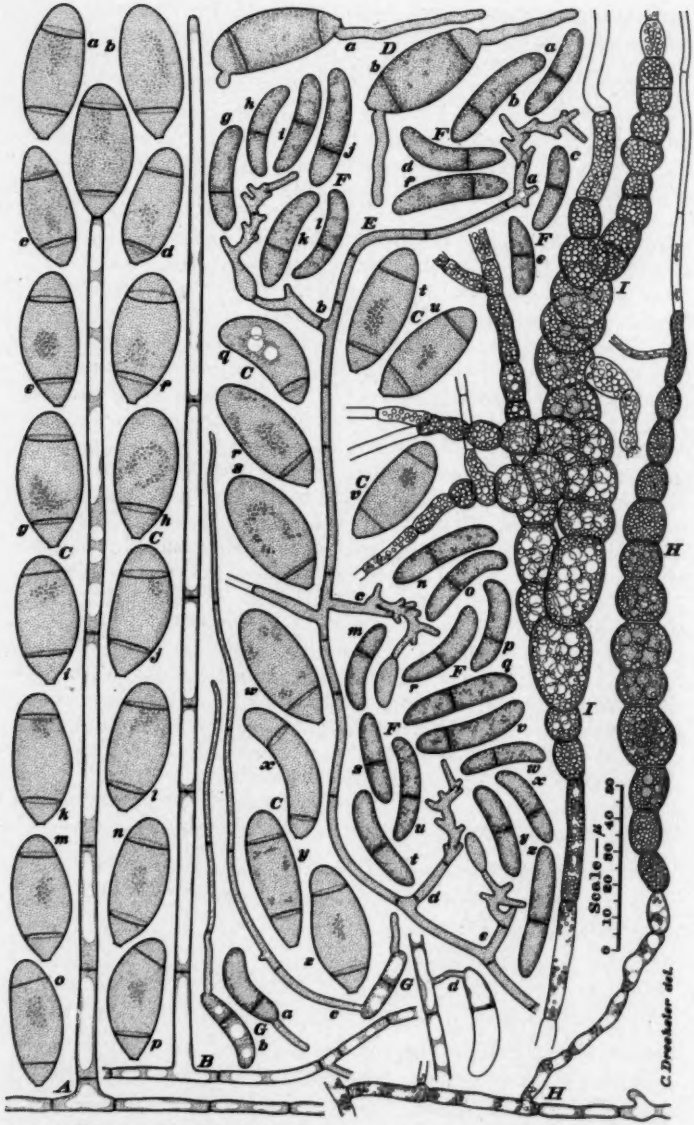

FIG. 2. *Dactylella heterospora* from pure Petri-plate cultures.

although it had come to light in his cultures under the same conditions that favored development of aggressively predaceous related forms, it had failed to show any predaceous behavior. The erect conidiophores (FIG. 3, *A*, *a–c; B*, *a–c*) formed very abundantly when this fungus was grown on Petri plates of maize-meal agar agreed well with those described and figured by Linder (**7**) in the original account of his *Dactylaria pulchra;* similarity being evident in dimensions and in a close arrangement of sterigmatic spurs along the irregularly rachiform tip. Since the conidia (FIG. 3, *C*, *a–q*) borne on the spurs likewise agreed in size, as also in shape and septation, to Linder's description, the Hawaiian fungus was held referable to *Dactylaria pulchra*, though owing to loss of all cultures derived from the material on which this species was based an actual comparison could not be made.

What would seem to be the same fungus appeared early in 1938 in some Petri plate cultures that had been started from discolored pieces of some lettuce (*Lactuca sativa* L.) seedlings found succumbing to damping-off in a greenhouse at the Bureau of Plant Industry Station near Beltsville, Md. The Maryland strain, though in the end no less prolific than the Hawaiian strain, was slower to begin sporulating. Two weeks after planting its conidial apparatus would, as a rule, hardly be visible to the naked eye anywhere within the area occupied by its pale submerged mycelium. After two additional weeks, however, the surface would usually be covered with a dense, somewhat pulverulent, almost crustose, markedly zonate, faintly yellowish layer, composed of conidiophores and conidia in extraordinary quantity, many of them present only as empty collapsed membranes. The predominance of conidia tapering almost equally toward both ends (FIG. 3, *C*, *c*, *h*, *i*) over those with a thicker, rather broadly rounded tip (FIG. 3, *C*, *a*, *b*) appeared often somewhat more pronounced in the Maryland strain than in the Hawaiian strain.

All the tests hitherto made to uncover predaceous or parasitic characteristics in the two strains have given negative results. Sizable slabs well permeated with vigorous young mycelium of the fungus were excised from maizemeal-agar plate cultures and transferred to agar plate cultures infested with saprophilous eel-

worms of such genera as *Rhabditis*, *Plectus*, *Cephalobus*, *Acrobeloides*, *Diploscapter*, *Wilsonema* and *Bunonema*. No predaceous organs were ever formed in consequence of this procedure, and no eelworms were ever captured or parasitized. Nor were any of the various amoebae and testaceous rhizopods likewise present in the infested cultures ever observed undergoing attack by the fungus.

A DACTYLELLA BEARING SIX–SEPTATE FUSIFORM CONIDIA IN OPEN RACEMOSE ARRANGEMENT

Three weeks after a pinch of leaf mold taken from deciduous woods near Beltsville, Md., in February 1938, had been added to a maizemeal-agar culture thoroughly permeated with mycelium of *Pythium ultimum* Trow, delicate submerged hyphae bearing small globose knobs and non-constricting rings were found developing in a tract of substratum adjoining the deposit of forest refuse. As the adhesive knobs and more especially the non-constricting rings served effectively in the destruction of eelworms present in the culture, it was apparent that the hyphae obtained their nourishment mainly, if not solely, from the animals they consumed. In manner of operation, as also in morphology, the predaceous organs offered a close parallelism with those of *Dactylella lysipaga* Drechsl. (**2**: p. 499–504) and *Dactylaria candida* (Nees) Sacc. (**2**: p. 523–527). Reproductive apparatus likewise recalling these two species subsequently came to light in a sparse array of conidiophores that bore hyaline, septate, fusiform conidia singly or, at times, in groups of two or three. Rather unexpectedly, however, most of the conidia were found divided by six cross-walls—a number not hitherto observed in *D. lysipaga*, and only occasionally seen in *D. candida*. In order that the departure in septation might be studied better, the meager sporulating material was removed to facilitate aseptic transfer of the conidia to sterile maizemeal agar.

The fungus thus obtained free of alien organisms grows with moderate rapidity in pure culture to produce a pale colorless submerged mycelium of fairly close texture. After several days a few conidiophores may often be discovered under the microscope, though two or three weeks usually elapse before their increasing

numbers become visible to the naked eye as a delicate turf. At this later stage of development they frequently bear in rather open racemose arrangement more than half a dozen conidia (FIG. 3, *D*), which, judging from the positional relationships of the supporting spurs (FIG. 3, *E; F, a, b*), have obviously been formed one after another on successive subapical prolongations. The six-septate condition most characteristic of the spores formed in the original nematode-infested culture predominates also in those produced in pure culture (FIG. 3, *G, a–n*). Among 100 conidia selected at random in a mount prepared from a maizemeal-agar plate culture 16 days after planting, 3 were found divided by 7 septa, 55 by 6 septa, 35 by 5 septa, 6 by 4 septa, and 1 by 3 septa. Measurements of the same 100 spores gave values for length, expressed to the nearest integral number of microns, distributable as follows: 29 μ, 1; 34 μ, 1; 35 μ, 1; 36 μ, 2; 37 μ, 1; 38 μ, 3; 39 μ, 3; 40 μ, 7; 41 μ, 6; 42 μ, 9; 43 μ, 11; 44 μ, 8; 45 μ, 7; 46 μ, 11; 47 μ, 10; 48 μ, 4; 49 μ, 5; 50 μ, 4; 51 μ, 4; 52 μ, 1; 54 μ, 1; and values for width with the following distribution: 8 μ, 4; 9 μ, 55; 10 μ, 38; 11 μ, 3. Most of the relatively few conidia that contained only 3 or 4 cross-walls were clavate in shape, while the much more numerous and more perfectly developed spores that contained 5, 6, or 7 cross-walls were, as a rule, rather symmetrically fusiform.

Sizable slabs of maizemeal agar newly permeated with mycelium of the fungus have at various times been placed on agar cultures well infested with eelworms. In no instance, however, has this procedure led to development of predaceous organs, or provoked predaceous activity. Perhaps the fungus is adapted to capture animals only under rather special environal conditions, which may have been lacking in all the tests hitherto made. On the other hand, it is about equally possible that the conidia originally used in starting the pure culture had no connection with the submerged hyphae bearing adhesive knobs and constricting rings in proximity to them.

The fungus provides another example of the troublesome intergradation between *Dactylella* and *Dactylaria* discussed in a previous paper (**3**: p. 467). It is referred to the former genus partly because on nematode-infested agar, where members of the pre-

daceous series commonly show the same sporulating habit as on their natural substrata, its production of plural conidia was hardly on a scale to permit capitate arrangement. To bring into relief one of the features setting it apart from several closely related forms, it is described under a specific name having reference to the frequent division of its conidia into seven segments.

Dactylella heptameres sp. nov.

Mycelium effusum; hyphis sterilibus hyalinis, septatis, ramosis, plerumque 1.5–3 μ crassis; hyphis fertilibus hyalinis, septatis, primum erectis, vulgo 50–150 μ altis, basi 2.5–3.5 μ crassis, sursum 1.5–2 μ crassis, apice uno conidio genito aliquando 1–10 μ subter apicem a latere identidem repullulantibus et ex incrementis saepius 5–35 μ longis 5–10 alia conidia deinceps gerentibus, itaque postea in parte supera plus minusve ramosis et aliquid degravatis; conidiis hyalinis, plerumque fusoideis, subinde clavatis, 3–7-septatis plerumque 6-septatis, 29–52 μ (saepe circa 44 μ) longis, 8–10.8 μ (saepe circa 9.3 μ) crassis.

Habitat in humo silvestri prope Beltsville, Maryland.

Mycelium spreading; vegetative hyphae colorless, septate, branched mostly 1.5 to 3 μ wide; conidiophores colorless, septate, at first erect, commonly 50 to 150 μ high, 2.5 to 3.5 μ wide at the base, 1.5 to 2 μ wide at the tip, sometimes after producing one conidium repeatedly growing out 1 to 10 μ below the apex to produce 5 to 10 additional conidia on the apices of successive prolongations mostly 5 to 35 μ in length, thereby often becoming somewhat branched and weighed down distally; conidia colorless, mostly spindle-shaped, occasionally club-shaped, divided by 3 to 7 cross-walls, most often divided by 6 cross-walls, 29 to 52 μ (average 44 μ) long, 8 to 10.8 μ (average 9.3 μ) wide.

Occurring in leaf mold near Beltsville, Md.

A DACTYLELLA BEARING SEVEN-SEPTATE CONIDIA IN OPEN ARRANGEMENT

Fifteen days after some pinches of leaf mold from a supply collected in deciduous woods near Beltsville, Md., in January 1938, were planted on a maizemeal-agar culture newly permeated with mycelium of *Pythium Butleri* Subr., slender erect unbranched conidiophores (FIG. 3, *H*, *a*, *b*) were found scattered sparsely in a tract of substratum adjoining one of the deposits of decaying material. Each of these conidiophores produced at its tip only a single conidium, though frequently after falling over on the agar medium, now abundantly infested with nematodes, amoebae,

and bacteria, it continued to serve a reproductive function by giving rise from one of its proximal segments to a second conidiophore; the same process being repeated, in some instances, half a dozen times. The conidia here produced (FIG. 3, *I*, *a–k*) were clavate in shape and contained usually 7 cross-walls. They varied mostly between 42 μ and 60 μ in length, and between 7.6 μ and 9.6 μ in width; measurements of the two dimensions gave average values of 52.7 μ and 8.6 μ, respectively.

By aseptic removal of the conidia from their supporting hyphae, the fungus was readily obtained free of alien microorganisms. Growing in pure culture on maizemeal agar it ordinarily advances more than 2 mm. a day to produce a pale mycelium of rather close texture. From the superficial hyphae conidiophores are sent up, which like the conidiophores of *Dactylella heptameres* formed in pure culture, eventually often produce 5 to 10 conidia in loose arrangement (FIG. 3, *J*). The first conidium is borne commonly at a height between 75 μ and 100 μ; the others being formed singly on branches that sometimes come directly from the main axis (FIG. 3, *K*), but more often are put forth one after another in a zigzag series (FIG. 3, *L–N*). When sporulation takes place abundantly in pure culture the conidia (FIG. 3, *O*, *a–t*) have been found to vary in length mostly between 36 μ and 53 μ, and in width between 6.7 μ and 9 μ; measurements of the two dimensions yielding averages of 44.5 μ and 8.1 μ respectively. The 7-septate condition predominates here hardly less strongly than in the original nematode-infested culture. Conidia with 8, 9, or 10 cross-walls are formed in relatively small numbers.

The fungus appears to differ rather markedly from the several related species that have been described as producing clavate spores. Its conidia, on the one hand, are decisively wider than those of *Monacrosporium subtile*, which according to Oudemans' (**10**) account measure 45 to 70 μ in length and 5 to 7 μ in width; while, on the other hand, they are decisively narrower than the massive spores of *Dactylella minuta* that were set forth by Grove (**5**) as ranging in length from 60 to 70 μ, and in width from 14 to 15 μ. When comparison is extended to *M. sarcopodioides* (Harz) Berl. et Vogl. (**11**: p. 552) whose clavate spores, 35 to 38 μ long, are divided by only 3 to 5 cross-walls, a pronounced dif-

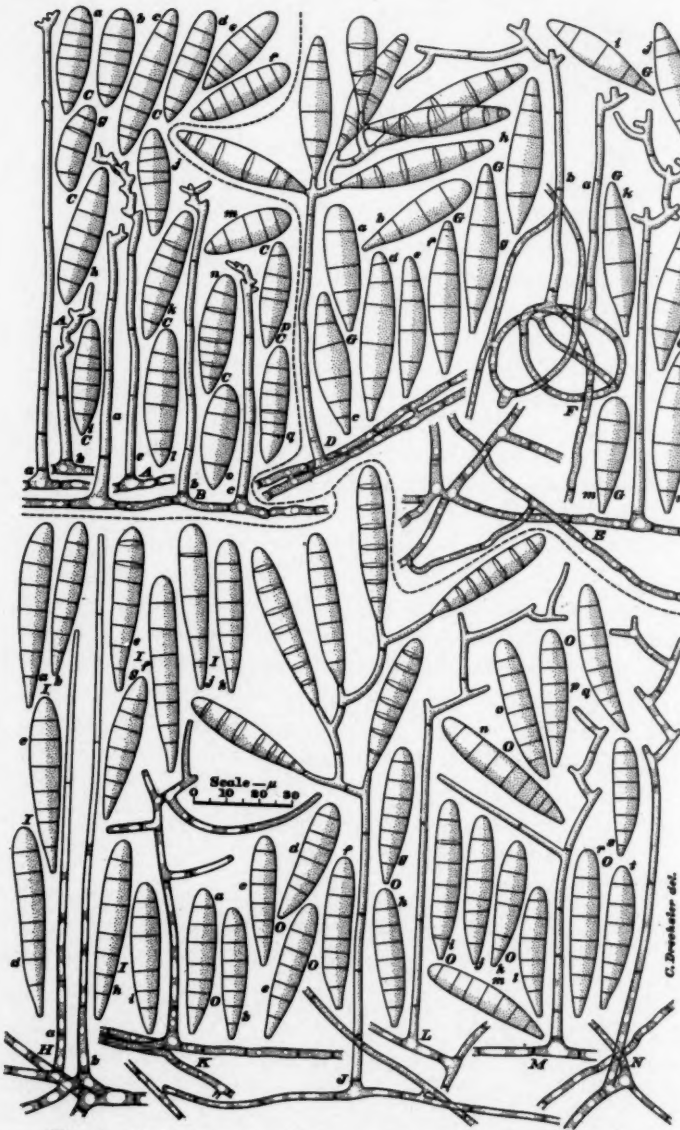

FIG. 3. *A–C, Dactylaria pulchra; D–G, Dactylella heptameres; H–O, Dactylella rhopalota.*

ference in conidial septation comes to light. The fungus manifestly is not to be identified with any form producing mostly spindle-shaped conidia. It is accordingly described as a new species under a name meaning "club-shaped."

Dactylella rhopalota sp. nov.

Mycelium effusum; hyphis sterilibus hyalinis, septatis, ramosis, plerumque 1–3 μ crassis; hyphis fertilibus hyalinis, septatis, primum erectis, plerumque 50–200 μ altis, basi 2.5–4 μ crassis, sursum attenuatis, apice 1–2 μ crassis, uno conidio genito saepe procidentibus denique hypham fertilem ordinis secundi prope basin proferentibus, saepe stantibus et 1–20 μ subter apicem a latere identidem repullulantibus et ex incrementis vulgo 10–50 μ longis 5–10 alia conidia gerentibus itaque postea in parte supera ramosis et aliquid degravatis; conidiis hyalinis, plerumque clavatis subinde paene cylindraceis, 3–10-septatis plerumque 7-septatis, 36–60 μ longis, 6.7–9.6 μ crassis.

Habitat in humo silvestri prope Beltsville, Maryland.

Mycelium spreading; vegetative hyphae colorless, septate, branched, mostly 1 to 3 μ wide; conidiophores colorless, septate, at first erect, mostly 50 to 200 μ high, 2.5 to 4 μ wide at the base, tapering upward, 1 to 2 μ wide at the tip, after forming a single terminal conidium sometimes falling over on the substratum and giving rise near the base to a second conidiophore, sometimes remaining standing and repeatedly growing out 1 to 20 μ below the apex to produce 5 to 10 additional conidia on the apices of branches or of successive prolongations mostly 10 to 50 μ in length, thereby becoming somewhat ramified and weighed down distally; conidia colorless, mostly clavate, occasionally more nearly cylindrical, 36 to 60 μ long, 6.7 to 9.6 μ wide.

Occurring in leaf mold near Beltsville, Md.

A DACTYLELLA BEARING TEN-SEPTATE CONIDIA IN LOOSE RACEMOSE ARRANGEMENT

A very prolific species of *Dactylella* has repeatedly made its appearance in maizemeal-agar plate cultures which after being permeated with *Pythium* mycelium had been further planted with small quantities of partly decayed tomato leaves collected in winter from greenhouse beds. The filaments of its sparse mycelium have never been observed attacking any of the various nematodes and protozoans that multiplied in the cultures after the decaying material was added.

The fungus shows greater tolerance toward bacteria than most other members of the predaceous series of hyphomycetes. Even

in the heavily contaminated original cultures its conidiophores often grew so luxuriantly that here and there groups of them became visible to the naked eye as minute white aerial tufts. When conidia were transferred from these tufts to sterile maize-meal agar, pure cultures were promptly obtained; the mycelium extended in the absence of alien organisms being pale, colorless, and of close texture. In Petri plate cultures conidiophores are ordinarily sent up within a few days and continue to develop usually for about a month; so that eventually they often make up a felty layer, which sometimes is white, and at other times has a faint pinkish or yellowish coloration. The extraordinarily copious sporulation revealed in such a layer is achieved in large part through repeated branching and subapical prolongation of the individual conidiophore, which as a result often comes to bear more than a score of conidia (FIG. 4, *A*). Owing to pronounced irregularity in the manner of branching (FIG. 4, *B–G*) the arrangement of the conidia can be designated only rather approximately as loosely racemose.

By far the greater proportion of conidia (FIG. 4, *H–Z*) are spindle-shaped, and show little difference in conformation between their proximal and distal ends. A clavate shape, much as in *Dactylella heptameres*, often distinguishes the shorter, undersized specimens (FIG. 4, *H*, *M*, *Q*, *X*), which contain mostly from 3 to 7 cross-walls. In the fusiform specimens, where the number of cross-walls varies from 7 to 13, the 10-septate condition predominates strongly. Clavate and fusiform specimens were taken indiscriminately in selecting at random the 100 conidia whose measurements were used in preparing the statement on conidial dimensions given in the diagnosis. The 100 measurements for length gave values distributable in classes as follows: 26–30 μ, 3; 31–35 μ, 1; 36–40 μ, 1; 41–45 μ, 2; 46–50 μ, 1; 51–55 μ, 5; 56–60 μ, 12; 61–65 μ, 43; 66–70 μ, 25; 71–75 μ, 6; 76–80 μ, 1; while the measurements for width gave values, expressed to the nearest integral number of microns, distributable thus: 7 μ, 4; 8 μ, 18; 9 μ, 61; 10 μ, 17

Although the fungus recalls *Monacrosporium oxysporum* Sacc. et March., described from excrement of caterpillars in Brussels (**9**), its conidia are not only considerably shorter than those of

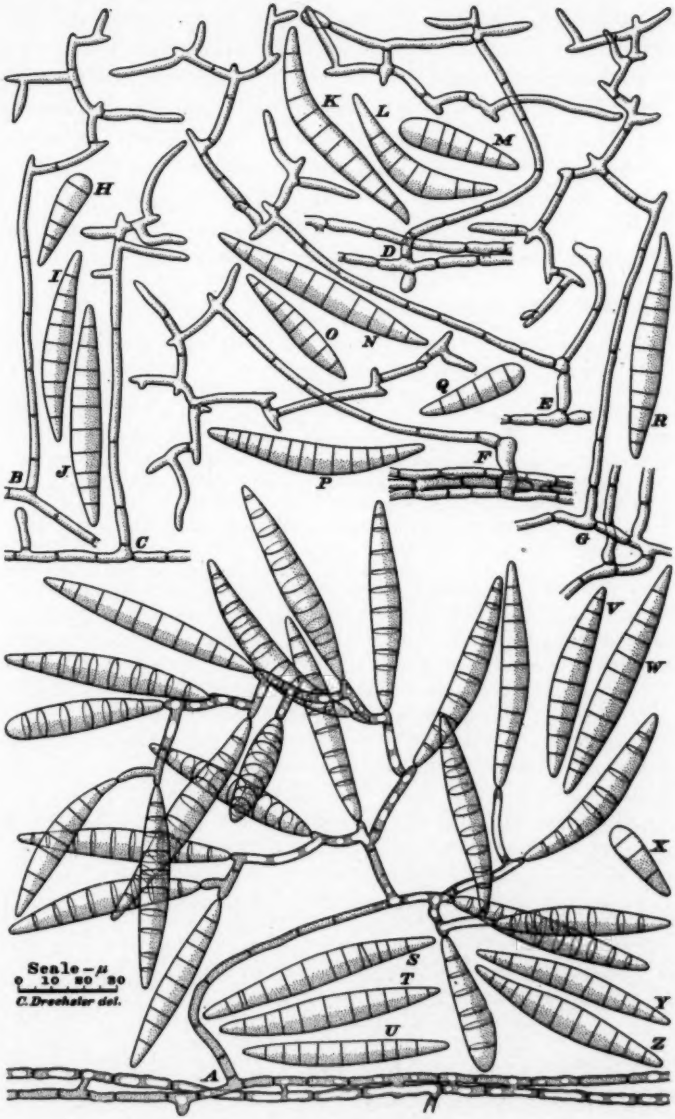

FIG. 4. *Dactylella atractoides.*

the Belgian species but differ further in that they are rounded at both ends rather than acutely pointed. Much greater similarity in conidial morphology is evident when comparison is made with *Dactylella minuta* var. *fusiformis* Grove (**6**), and the likelihood of identity with this variety cannot readily be dismissed. However as my fungus appears wholly alien to typical *D. minuta*, which produces decidedly wider conidia of clavate shape, I am describing it as a separate species, under an epithet different from the varietal name used by Grove, but of similar meaning.

Dactylella atractoides sp. nov.

Mycelium effusum; hyphis sterilibus hyalinis, septatis, ramosis, plerumque 1–4 μ crassis; hyphis fertilibus hyalinis, septatis, primum erectis, basi 3–5 μ crassis, sursum 2.5–3 μ crassis, uno conidio genito 2–20 μ subter apicem a latere identidem repullulantibus et ex incrementis 5–40 μ longis 5–25 alia conidia gerentibus itaque postea usque 300 μ longis aliquantum ramosis degravatisque; conidiis hyalinis, plerumque fusiformibus, subinde clavatis, rectis vel nonnihil curvatis, 3–13-septatis (septis saepius denis), 26–76 μ (saepius circa 62 μ) longis, 7.2–10.2 μ (saepius circa 8.8 μ) crassis.

Habitat in foliis Lycopersici esculenti putrescentibus prope Beltsville, Maryland.

Mycelium spreading; vegetative hyphae hyaline, septate, branched, mostly 1–4 μ wide; conidiophores hyaline, septate, at first erect, 3 to 5 μ wide at the base, 2.5 to 3 μ wide above, after attaining a length frequently of 100 to 125 μ and producing a terminal conidium repeatedly growing out laterally 2 to 20 μ below the apex to produce 5 to 25 additional conidia on the apices of branches or prolongations often 5 to 40 μ in length, thereby becoming rather extensively ramified; conidia colorless, mostly spindle-shaped, occasionally club-shaped, straight or somewhat curved, divided by 3 to 13 cross-walls, most often divided by 10 cross-walls, measuring 26 to 76 μ (average 62 μ) in length and 7.2 to 10.2 μ (average 8.8 μ) in width.

Occurring in decaying leaves of *Lycopersicon esculentum* Mill. near Beltsville, Md.

DIVISION OF FRUIT AND VEGETABLES CROPS AND DISEASES,
BUREAU OF PLANT INDUSTRY STATION,
BELTSVILLE, MARYLAND

LITERATURE CITED

1. **Buller, A. H. R.** Researches on fungi. vol. 5. 416 pp. 1933.
2. **Drechsler, C.** Some hyphomycetes that prey on free-living terricolous nematodes. Mycologia **29**: 447–552. 1937.

3. ——. Three new hyphomycetes preying on free-living terricolous nematodes. Mycologia **32**: 448–470. 1940.
4. ——. Some hyphomycetes parasitic on free-living terricolous nematodes. Phytopathology **31**: 773–802. 1941.
5. **Grove, W. B.** New or noteworthy fungi. Jour. Bot. **22**: 129–136, 195–201. 1884.
6. ——. New or noteworthy fungi: Part III. Jour. Bot. **24**: 129–137, 197–206. 1886.
7. **Linder, D. H.** North American Hyphomycetes II. New species and a new genus. Mycologia **26**: 436–440. 1934.
8. **Linford, M. B.** Stimulated activity of natural enemies of nematodes. Science **85**: 123–124. 1937.
9. **Marchal, É.** Champignons coprophiles de Belgique. Bull. Soc. Roy. Bot. Belgique **24**: 57–77. 1885.
10. **Oudemans, C. A. J. A.** Aanwinsten voor de flora mycologica van Nederland, IX en X. Nederl. Kruidk. Arch. II. **4**: 203–278. 1885.
11. **Saccardo, P. A.** Sylloge fungorum. vol. 10. 1892.

EXPLANATION OF FIGURES

FIG. 1. *Dactylella heterospora* as found developing on nematode-infested maizemeal-agar plate cultures; drawn to a uniform magnification with the aid of a camera lucida, and reproduced at an enlargement of 500 diameters. *A*, *B*, Portions of hyphae, each bearing two open predaceous rings, *a* and *b*. *C–F*, Portions of hyphae, each bearing an open predaceous ring. *G*, *H*, Portions of hyphae, on each of which is borne a ring that after closing on a specimen of *Plectus parvus* has intruded several growing assimilative filaments into the fleshy interior of the captive. *I*, Portion of hypha bearing three predaceous rings, *a*, *b*, and *c*, of which *b* and *c* are open; the ring *a*, after closing on a specimen of *P. parvus*, has extended haustorial filaments lengthwise throughout the animal. *J*, Portion of prostrate hypha from which two tall conidiophores have originated; one of them, *a*, shown with the single large conidium attached; the other, *b*, shown in a denuded state. *K*, Small portion of mycelium with a denuded tall conidiophore. *L*, Random assortment of large conidia, *a–w*, showing variations in size, shape, and septation. *M*, Conidium of large type germinating by production of a single germ tube. *N*, *O*, Large conidia germinating by production of two germ tubes. *P*, Conidium of large type that has put forth a germ conidiophore bearing a secondary conidium.

FIG. 2. *Dactylella heterospora* as found developing in pure culture on maizemeal-agar plates; drawn to a uniform magnification with the aid of a camera lucida, and reproduced at an enlargement of 500 diameters. *A*, Portion of a prostrate hypha with a tall conidiophore to which is attached the single large conidium produced on it. *B*, Portion of a prostrate hypha with a tall conidiophore in denuded state. *C*, Random assortment of large conidia, *a–z*, showing variations in size, shape, and septation. *D*, Two large conidia, *a* and *b*, germinating by production of a germ tube from each end cell. *E*, Prostrate filament that has produced smaller conidia on the apices of rachiform prolongations extended from its tip, *a*, and from four lateral branches, *b–e*. F, Random assortment of conidia of the smaller type, *a–z*, showing variations

in size, shape, and septation. *H*, Unbranched resting body. *I*, Branched resting body.

FIG. 3. Drawn to a uniform magnification with the aid of a camera lucida; × 500 throughout.

A–C, Dactylaria pulchra: A, Portions of procumbent hypha, *a–c*, each with a denuded conidiophore. *B*, Portion of procumbent hypha with three erect conidiophores, *a–c*, in denuded condition. *C*, Random assortment of conidia, *a–q*, showing variations in size, shape, and septation.

D–G, Dactylella heptameres as found developing in pure culture on Petri plates of maizemeal agar sixteen days after planting: *D*, Portion of mycelium with a conidiophore bearing seven conidia. *E*, Portion of mycelium with a denuded conidiophore on which ten conidia were produced. *F*, Portion of mycelium with two conidiophores, *a* and *b*, which produced, respectively, three and six conidia. *G*, Detached conidia, *a–n*, showing variations in size, shape, and septation.

H, I, Dactylella rhopalota as found developing in a maizemeal-agar plate culture infested with nematodes, amoebae, and bacteria: *H*, Portion of mycelium with two denuded conidiophores, *a* and *b*, on each of which a single conidium was produced. *I*, Detached conidia, *a–k*, showing variations in size, shape, and septation.

J–O, Dactylella rhopalota as found developing in pure culture on Petri plates of maizemeal agar: *J*, Portion of mycelium with a conidiophore bearing six conidia. *K–N*, Portions of mycelium, each with a denuded conidiophore; in *K*, *L* and *N* six conidia were abjointed, in *M* five were abjointed. *O*, Detached conidia, *a–t*, showing variations in size, shape, and septation.

FIG. 4. *Dactylella atractoides* as found developing in pure culture on Petri plates of maizemeal agar; drawn to a uniform magnification with the aid of a camera lucida, and reproduced at an enlargement of 500 diameters. *A*, Portion of mycelium with a conidiophore bearing twenty-two conidia. *B–G*, Portions of mycelium, each with a denuded branching conidiophore; presumably nine conidia were abjointed in *B*, seven in *C*, nine in *D*, fourteen in *E*, eighteen in *F*, and eighteen in *G*. *H–Z*, Detached conidia showing variations in size, shape, and septation.

NOTES ON THE MYCETOZOA—VII

ROBERT HAGELSTEIN

The restrictions of the war efforts curbed somewhat our collecting activities during the season of 1942. A few days were spent in Schoharie County, New York, where, among other forms, the rare *Diderma Sauteri* (Rost.) Macbr. was found. A week's stay in Pike County, Pennsylvania, during the latter part of August, with 30 hours of actual field work, yielded 96 species in 30 genera. In Pike County we stop at Shohola Falls in a small inn kept by Mr. and Mrs. Flanagan. The beautiful falls and gorge of the Shohola Creek are within a few minutes walk from there. The house is on a mountain-side at an altitude of 1248 feet, surrounded by the deep forest, and the nearest other house is a mile away. Some of our best finds have been made around that inn in short rambles before breakfast and after supper. *Diderma Sauteri* was again found about a hundred feet below the house on a mossy rock in a moist area. Mr. Rispaud made extensive collections at Mitchell Field, Long Island, where he is employed, and among them was *Trichia lutescens* Lister.

One of the most interesting and instructive collections we have ever made was at Jericho, Long Island, New York. Here, on a private estate, workmen had cut logs from the adjoining forest and stacked them for use as fire-wood during the approaching winter. Mr. Rispaud visited the pile in early September, and among other forms, found a fine development of *Perichaena chrysosperma* on the top bark of one of the logs which appeared to be a species of elm. On examining it at home, and after study, we found the following other forms of *Perichaena* present, all jumbled together and intermingled, sometimes sporangia of one species fruiting on those of another, and all in splendid condition: *P. corticalis*, *P. corticalis* var. *liceoides*, *P. depressa*, *P. minor*, *P. minor* var. *pardina*, and the phase of *P. depressa* regarded by Macbride as *P. quadrata*. With the plasmodia of nearly every form of the genus *Perichaena* known from North America in one

log, it may well be reasoned that some of them are not species, but more likely, intermediates or hybrids. Some of the forms mentioned are extremely rare. They are discussed later in this paper.

ARCYRIA GLOBOSA Schw. It is significant that this species was found twice on ground leaves of the chestnut oak (*Quercus Prinus* L.) in Pike County, Pennsylvania, during August. We have never found it before in this general area, although there are many large, dead chestnut trees still standing and also young saplings. The species was common and abundant on chestnut burs before the destruction of the trees by the blight, and possibly it has adapted itself to another habitat. N. Y. B. G. Nos. *2330, 2342.*

CERATIOMYXA FRUTICULOSA (Muell.) Macbr. The generally recognized variety *porioides* of this species is not a distinct variety, but merely a phase developing from the same plasmodium as the typical form, only, under conditions of greater moisture. This was clearly observed during our visit to a large pile of sawdust in Pike County, Pennsylvania, in August. The last of the frequent, heavy, preceding rains had fallen three days before our visit, and the sawdust was still so wet below that our feet sank deeply into it. The dryer layer on top was covered with many fruitings of a number of species, among which were numerous developments of *C. fruticulosa*, all of which more or less, showed the honey-comb structure and free sporophores with transition from one to the other in the same colony. Unquestionably, this proceeds when moisture conditions change during the time of the formation of the fruiting bodies. The fragile character of the habitat made it impossible to transport much of the material, and this little was badly broken when we reached home. In the past, we have found several specimens on wood.

COMATRICHA RISPAUDII Hagelstein. Collected three times in different sections of Pike County, Pennsylvania, in August. N. Y. B. G. Nos. *2302, 2360, 2365.*

CRATERIUM MINUTUM (Leers) Fries. This species occasionally forms long, cylindrical sporangia with white, convex lids. We have found the phase several times, and another fine collection was made by Robert H. Rispaud, on the leaf pile mentioned under *Physarum superbum.* This variety bears the same relation to the

typical form of *C. minutum* that var. *cylindricum* does to the typical form of *Craterium leucocephalum* (Pers.) Ditm. N. Y. B. G. No. *2152*.

DIANEMA CORTICATUM Lister. The form seems to be quite common on dead pine in Pike County, Pennsylvania. It was found again in August, and like former collections from there, it appears to have no capillitium. N. Y. B. G. No. *2346*.

DIDERMA ANTARCTICA (Speg.) Sturg. Mycologia **8**: 37. 1916. Dr. Sturgis, in the paper cited, described specimens gathered by Prof. Roland Thaxter at Punta Arenas, Chile, believing they conformed to the description of *Licea antarctica* Speg. Bol. Acad. Nat. Cienc. Cord. **11**: 56. 1887. A translation of Spegazzini's description appeared in Lister, Mycetozoa 151, 1894, and suggests as Lister says, a form of the genus *Perichaena*. Apparently, the type specimen of Spegazzini was not examined as it was unavailable, and all later descriptions and figures of *D. antarctica* are based on Thaxter's specimens and Sturgis' conception.

The Thaxter specimens used by Sturgis are now in the Herbarium of the New York Botanical Garden. The sporangia resemble those of *Diderma asteroides* Lister. In many of the sporangia there are no columellae at all, merely thickenings of the sporangial floors with lime. In others, where a columella is present, it consists of an irregular mass of lime composed of smaller irregular masses, and occasionally there are spike-like, calcareous processes extending from the columella or from the wall, to which processes the capillitium is attached. The capillitium is very irregular and differs in almost every sporangium. It consists of rigid threads radiating from wide expansions, the threads usually broad and irregular along the sides. Sometimes the expansions are absent, or there are but few threads attached to the base, or to the columella and wall. The threads are often attached to the processes or lumps of the columella. The spores when fully swollen do not have any ridges, and are like the spores of *D. asteroides*, but if imperfectly swollen, show the lines of the earlier contraction brought about by long and thorough drying. There is no constancy whatever throughout the colonies, and they are surely abnormal forms of some species of the genus *Diderma*, probably *D. asteroides*, as I regard them. I have already noted

similar forms in *Diderma spumarioides* (Mycologia **33**: 301. 1941) and in *Diderma simplex* (Mycologia **34**: 256. 1942). Plunkett (Pub. Univ. Calif. Biol. Sc. **1**: 41. 1934) reports as *D. antarctica* two collections from California, and mentions differences between them and published descriptions and figures of *D. antarctica*. There appear to be no other records. N. Y. B. G. Nos. *12486*, *12487*.

DIDERMA SAUTERI (Rost.) Macbr. This extremely rare species was found in fair abundance at Shohola Falls, Pike County, Pennsylvania, in August, associated with *Lamproderma columbinum* (Pers.) Rost.; and a small gathering was made by Robert H. Rispaud, the young son of Mr. Rispaud Sr., at Middleburg, Schoharie County, New York, in July. N. Y. B. G. Nos. *2344*, *2368*.

DIDYMIUM STURGISII Hagelstein. The species was observed on the bark of many ash trees in Pike and Wayne Counties, Pennsylvania, during August, and widely separated by miles. The developments were on standing trees, or such as had fallen with one or both ends elevated above the ground. Countless small plasmodiocarps extended for many feet around the dead trunks. The form was also collected for the first time on Long Island, New York, on dead poplar bark, in August. N. Y. B. G. Nos. *2148*, *2351*, *2355*, *2356*.

ELAEOMYXA MIYAZAKIENSIS (Emoto) Hagelstein, Mycologia **34**: 593. 1942. The species was described originally by Emoto as *Diachea miyazakiensis* (Proc. Imp. Acad. Tokyo **11**: 444. 1935) on material found in Japan. It has been collected repeatedly by Mr. Eli Davis and Mr. W. D. Sutton near London, Ontario, and may occur elsewhere in North America. As Emoto's German description is not readily obtainable, a translation is appropriate.

Plasmodium not observed; total height 1 to 1.5 mm.; sporangia gregarious, cone-shaped, stalked, blue or irridescent violet; sporangial wall membranous, transparent, sometimes with pale orange oil granules; stalk cylindrical, somewhat thicker in the middle, brownish black, 0.1 to 1 mm. long, about 0.05 mm. diam.; hypothallus not developed; columella reaching to half the height of the sporangium, violet-brownish black, dividing into branches, without lime; capillitium springing from the columella, of branching and anastomosing, dark violet-brown threads, colorless at the

tips, and having at the axils oil bearing nodules, 5–30 μ diam., pale orange or pale orange-red, containing many granules; spores globose, dark violet-brown, warted, 7–10 μ diam.

Emoto used the German word for oil to explain the material in the sporangial wall and capillitium. *Elaeomyxa cerifera* (G. Lister) Hagelstein has a similar substance in the stalk, and Miss Lister considered this as wax. Emoto may have used the word oil as synonymous with wax. In the Ontario specimens the substance is solid at ordinary temperatures. The thickness of the stalk, 0.05 mm., as given by Emoto does not agree with his accompanying figure. This is probably an error and should be about 0.25 mm. which would coincide with his figure and the stalks of the Ontario material.

FULIGO INTERMEDIA Macbr. In prior Notes (Mycologia **29**: 398–400. 1937, and **33**: 304–305. 1941), I referred to numerous aethalia of a *Fuligo* found at Middleburg, Schoharie County, New York, and regarded therein as *Fuligo septica* (L.) Weber.

At Mitchell Field, Long Island, New York, there were in August many large, poplar logs which had been cut somewhere else on Long Island and removed to the Field. The logs were on open ground and exposed to the sun. On these logs appeared at that time, and several times thereafter at intervals, hundreds of aethalia of the same form reported from Middleburg, identical in appearance and characters with the earlier developments, and with a layer of perfected sporangia on the outside instead of a cortex. Also, there were many small clusters of heaped, confluent, irregularly shaped sporangia, often 1 mm. or less across, and occasionally single sporangia, sessile or attached to stalk-like strands of the hypothallus. In the clusters there is no clear evidence of an aethalioid formation. All forms were associated with many aethalia of *Mucilago spongiosa* (Leyss.) Morg. var. *solida*.

Judged by the constancy of this large mass of material, I am convinced the form deserves specific rank. Specimens collected by Prof. Bethel in Colorado are at hand, as well as others from California, Florida and Kansas. *F. intermedia* is based on similar collections made by Bethel, and the New York material is the same. The form was not correctly described by Macbride, so a description based on the New York material follows.

Aethalia pulvinate or depressed, sometimes confluent or annulate, dirty white, greenish white, or ochraceous, 1 to 6 cm. across, usually forming many aethalia from a single plasmodium, occasionally forming small clusters of heaped sporangia. Cortex absent. The inner structure of the aethalium is like that of *Fuligo septica*. The twisted and confluent sporangia of the outer layer are well developed with walls, capillitia and spores. Sporangial wall membranous, colorless, densely covered with a compacted shell of white lime-granules, sometimes separable. Capillitium of short threads connecting large, white, branching lime-knots, united in a dense mass at the center and *Badhamia*-like. Spores purplish brown, globose, 9–12 μ diam., with occasionally a few ovoid or ellipsoid spores, distinctly spinulose.

FULIGO SEPTICA (L.) Weber. The wet season produced many small, solitary aethalia of a *Fuligo* on leaves in wooded regions of Pike County, Pennsylvania, and Long Island, New York. These usually are small, less than 25 mm. across, although some years back we found one more than 30 cm. in size. They all have a labyrinthine structure, similar to the small rosettes of *Physarum gyrosum* Rost., but never accompanied by the latter. They have the small, pale spores of both species, and the lime-knots are fusiform and transversely placed. Usually the aethalia are gray from the absence of lime on the surface, but occasionally lime is present, and on one occasion we found an aethalium with a firm cortex. These forms have been erroneously regarded as phases of *F. cinerea* or plasmodiocarps of *P. gyrosum*, and, while they appear to be intermediate with the latter species, they have the aethalioid form of fructification, and nearer to *F. septica*.

LEPIDODERMA CARESTIANUM Rost. The three members of the genus *Lepidoderma* are characterized by the presence of vitreous discs or scales in pockets of the sporangial wall which are easily dislodged. This is a constant character, and must not be confused with the occasional presence in some species of *Physarum* and *Diderma* where the lime was originally deposited as granules, and by subsequent action of water and drying altered to similar discs or plates. *L. tigrinum* is well marked and easily recognized. The two other species, *L. Carestianum* and *L. Chailletii*, are not so clearly understood in North America because of the scarcity of authentic specimens. In Europe the forms are more abundant,

and are seen to represent the extremes of a long range of variation. In *L. Carestianum* the fructification is more or less plasmodiocarpous, and in typical examples the plasmodiocarps are flattened and effused. Such forms have been found in the mountains of New Hampshire and agree perfectly with the type material of *Reticularia Carestiana* Rabenh. (N. Y. B. G. No. *6816*). The sporangial wall in *L. Carestianum* is brown or purplish, and the capillitium has coarse threads which often have dark, bead-like warts. Var. *granuliferum* (N. Y. B. G. No. *5570*, type material), although regarded by some students as a distinct species, is hardly more than a variety of *L. Carestianum*. In the variety, there are expansions in the capillitium containing lime-granules. Similar lime-knots are seen occasionally in some species of the genus *Diderma*. The spores in the type specimen of var. *granuliferum*, collected by Harkness in California, are irregular and unusually large, 20–30 μ diam., a clear indication of abnormality. A collection made by Garrett in Utah (N. Y. B. G. No. *11223*) has more representative lime-knots, and the spores are 14–16 μ diam. The size of the spores in this group varies so much that it is of little significance in classification. Macbride and Martin (Myxomycetes 142. 1934) say that Harkness No. *35*, from Utah, in the Ellis collection, N. Y. Bot. Gard., belongs with *L. granuliferum* (Phill.) R. E. Fries, as they prefer to call the variety. The particular specimen is one of two mentioned on the following page (143) under *L. Carestianum*, as representing *Amaurochaete minor* Sacc. & Ellis. They are typical *L. Carestianum* and have no lime in the capillitium. Macbride and Martin probably intended to refer to Harkness No. *23/29* from California, which is type material of *Didymium granuliferum* Phill., and regarded as var. *granuliferum*.

L. Chailletii Rost. is distinguished from *L. Carestianum* by the more frequent habit of forming distinct sporangia, often with stalks arising from a hypothallus; the paler colored sporangial walls; and the more slender and smoother threads of the capillitium.

MARGARITA METALLICA (Berk. & Br.) Lister. The species is rare in eastern North America, and was found for the first time in Pike County, Pennsylvania, in August. N. Y. B. G. No. *2306*.

PERICHAENA CHRYSOSPERMA (Currey) Lister. On the bark of the log previously mentioned from Jericho, Long Island, were the finest developments of this species that we have ever found. They were beautifully matured, and consisted of large, dark brown, straight, curved or ring-shaped plasmodiocarps, with many subglobose to globose sporangia, often with little granular matter on the walls, and showing distinct papillae like on the wall of *Perichaena vermicularis* (Schw.) Rost. The globose sporangia range from 0.2 to 0.5 mm. diam., and the dehiscence is either irregular or by areolae. A few of the sporangia and plasmodiocarps have large dark warts, composed of granular refuse matter, on the outside like in *Perichaena minor* var. *pardina*. The capillitium in all these forms of *P. chrysosperma* is similar, except that the more robust ones have the spines on the capillitium a little longer. The threads of the capillitium are about 2.5 μ thick, irregularly constricted, and with numerous curved spines about 3 μ long.

Attention is called to an error in the Lister Monograph in the note following the description of *P. vermicularis*. Therein it says that the distinct papillose wall is a character by which the species is distinguished from all others of the genus *Perichaena*. The wall of *P. chrysosperma* is also papillose, and this is stated in the description of the species in the 3rd. edition of the Lister Monograph. N. Y. B. G. Nos. *2160–2164*.

PERICHAENA CORTICALIS (Batsch) Rost. On the bark of the log from Jericho, Long Island, were many sporangia of this species, associated with *P. chrysosperma* and other forms of the genus. The sporangia are of the phase where the dehiscence is horizontal with a well-defined, highly elevated, convex lid. Some of the sporangia are very small, 0.2 mm. diam., or even less. The capillitium is abundant, branched and netted, with threads 2 μ thick, which are fairly regular without constrictions, but with many minute spines. The spores are about 10 μ diam. Forms like these are close to *P. depressa* Lib., and probably intermediate therewith, but accepting the shape of the sporangia as the more important character, rather than the capillitium and spores, I have always regarded them as nearer *P. corticalis*. Developments with such sporangia, and associated with undoubted *P. depressa*

are not rare, and in the present collection a few sporangia of *P. depressa* were observed.

Widely scattered among all the forms of *Perichaena* present were many solitary sporangia of *P. corticalis* var. *liceoides* (Rost.) Lister. These are sessile, globose, 0.2 to 0.5 mm. diam., shining iridescent brown, blue or purple, and with irregular dehiscence. The sporangial wall is thin, membranous, smooth, translucent, pale yellowish, and with scanty refuse matter or none. The capillitium is scanty, with little branching, of nearly smooth, tubular threads, 1.5 μ diam. The spores are olivaceous in mass, pale yellow by transmitted light, faintly warted, 10–11 μ diam. N. Y. B. G. Nos. *2167*, *2168*.

PERICHAENA MINOR (G. Lister) Hagelstein, Mycologia **35**: 130. 1943. This species and var. *pardina* (Minakata) Hagelstein, l. c. were originally described by Miss Lister as having faint or inconspicuous spiral bands on the capillitium. The variety differs from the typical form in having dark, prominent warts, composed of granular refuse matter, scattered over the outside of the sporangial wall.

On the bark of the log at Jericho, Long Island, previously mentioned, the two forms were found about equally divided in numbers, in fair abundance, and associated with *P. chrysosperma*, *P. corticalis*, and other forms of the genus *Perichaena*. The sporangia are scattered, sessile, globose to subglobose, 0.2 to 0.5 mm. diam. Stalked forms were not observed, nor plasmodiocarps. The color of the typical form is dull yellow, and some of the sporangia have one or a few warts like in var. *pardina*. The variety has many of the characteristic warts, and between them the color is dull yellow or brownish when some of the refuse matter is present between. The sporangial wall is membranous, translucent, with stippling or papillae like in *P. chrysosperma*. The characters of the spores are of little significance as they are similar to the spores of all the associated forms of *Perichaena*, pale yellow, faintly marked, about 11 μ diam. The netted, yellow capillitium has threads 2.5–3.5 μ thick, irregularly constricted with many large, bulbous expansions, and large swollen free ends. The capillitium varies slightly in different sporangia.

When the capillitium is observed with an objective of inferior numerical aperture, faint groups of narrow, diagonal lines are seen on the threads here and there, not continuous, and often absent. Their direction is sometimes dextral and other times sinistral, and they do not seem to wind around the threads as they are not seen on the edges. They are not like the thickenings in the form of distinct windings found in the genera *Trichia* and *Hemitrichia*. When the same thread is observed with an apochromatic objective of N. A. 1.40, no lines or spiral windings are seen. The edge of the thread is studded with many close-set, minute, spines, less than 0.5 μ long. On the surface are numerous minute puncta, close together, which are the spines. Sometimes they are arranged in quincunx, like the puncta on the valves of many species of the Diatomaceae. At other times certain groups stand out more distinctly. All this tends to form diffraction illusions when an objective is used that will not resolve the lines into their component structure. The forms belong in the genus *Perichaena*, and not in *Hemitrichia*, in which latter genus there are true bands that wind around the threads.

The species has been reported heretofore naturally only from Japan and England, although Gilbert and Martin obtained it in moist chamber developments on material from Iowa and Ontario (Ia. Stud. Nat. Hist. **15** (3). 8. 1933). Miss Lister (Mon. ed. 3. 244. 1925) notes its association with *P. chrysosperma* in a collection from Japan. The capillitium resembles that of *P. vermicularis* (Schw.) Rost., but the latter was not associated in the Long Island gathering. The sporangia resemble the globose ones of *P. chrysosperma*, particularly the few that have similar dark warts like those on var. *pardina*. The typical form and var. *pardina* may be connecting forms, but have now been found in widely separated parts of the world, usually together, and seem to be good centers. The variety is far more distinctive than the typical form. More collections are required for the study of these interesting forms. N. Y. B. G. Nos. *2182*, *2183*, *2185*.

PHYSARUM ALPINUM G. Lister. The species is based primarily on a collection made by Harkness in the Blue Canon, California, and named in Phillips' herbarium *Badhamia inaurata*, which name was not published. No other collections like the California one

are known, except that Macbride (N. A. Slime-Moulds ed. 2. 55. 1922) mentions specimens from Washington believed to be the same, and indicates a relationship with *Physarum contextum* Pers. The California specimen is so strikingly different from *P. contextum*, that this record must be considered as somewhat doubtful.

The Harkness specimen was referred to by Lister (Mycetozoa 61. 1894), and then placed doubtfully with *Physarum rubiginosum* Fries. Later, A. & G. Lister (Jour. Bot. **46**: 216. 1908) proposed the form as var. *alpinum* of *Physarum virescens* Ditmar, including therewith certain forms from Switzerland. Neither the American nor the Swiss form has any resemblance to *P. virescens*. With additional material from Switzerland, Miss Lister (Jour. Bot. **48**: 73. 1910) proposed both forms jointly as *P. alpinum*. A portion of the Harkness collection, finely matured, is in the Herbarium of the New York Botanical Garden, and the Swiss forms are represented by five specimens received from M. Ch. Meylan.

The fructification of the California gathering is sporangiate, the large, sessile, subglobose, scattered or loosely clustered sporangia ranging from 1 to 1.4 mm. diam., and seated on a membranous hypothallus. The sporangial wall is double, the outer a dense crust of yellow lime, lightly affixed, and separating in flakes from the white, membranous, inner layer. The capillitium is a network of hyaline threads, with numerous large, angular and branching, yellow or yellowish lime-knots. The spores are purplish brown, faintly warted, 11–12 μ diam. The Swiss forms are in plasmodiocarps, some of them more than 25 mm. in length. The walls of the plasmodiocarps are firm, with massive, very pale yellow lime. Some of the few smaller plasmodiocarps, which may be considered as sporangia, have conical masses of lime arising from the bases, like columellae, and in some of the larger ones these are extended as low ridges. The lime-knots are small, angular and pale yellow. The spores are similar to those of the American form. The Swiss forms bear a close resemblance to *Physarum vernum* Somm., with which Miss Lister says they are associated, and may possibly represent a pale yellow phase of that species. They are surely not like the Harkness specimen, which,

if further similar gatherings are found constant, should be regarded as typical of the species, and the Swiss forms separated.

PHYSARUM AURISCALPIUM Cooke. In an earlier Note (Mycologia **29**: 402. 1937) I discussed the relations of this species to *Physarum oblatum* Macbr. and to *Physarum Maydis* (Morg.) Torr. Since then much additional material has been acquired, so that now there are more than 175 specimens of the three forms in the Herbarium of the New York Botanical Garden. A careful study of these specimens leads to the conclusion that *P. auriscalpium* and *P. oblatum* are distinct species, and that *P. Maydis* is a small phase of *P. oblatum*.

There are 30 specimens here of the form regarded as the true *P. auriscalpium* of Cooke. I know of no type material of *P. auriscalpium* existent in this country, although portions of the type specimen were in the British Museum and the Kew Herbarium at the time Lister examined them and published his description (Mycetozoa 61. 1894), and which he placed then provisionally with *Physarum rubiginosum* Fries, a sessile form. My opinion is therefore based on that description, the figures through the various editions of the Lister Monograph, and the original description of Cooke (Ann. Lyc. Nat. Hist. N. Y. **11**: 384. 1877). Both descriptions mention an almost obsolete stalk.

A description based on the 30 specimens follows:

Sporangia gregarious or clustered and angled by mutual pressure, sessile, circular to irregular shapes, pulvinate or depressed, 0.5 to 1.2 mm. diam., or forming short, curved or straight plasmodiocarps, mottled with brown, red, yellow, or white, with a dark red or brown inner base; sporangial wall membranous, firmer and persistent below, yellow, speckled on the outside with large, separated, clusters of reddish, yellowish, or white lime-granules; capillitium consisting of many large, angular, branched, or netted lime-knots, yellow, pale yellow, or nearly white, rarely tinged with red, connected by long or short hyaline threads; spores violet-brown, spinulose, 9–12 μ diam.

These forms differ from *P. oblatum* by the size and shape of the sporangia; the absence of distinct stalks; and the speckled appearance due to the vari-colored lime-granules on the outside of the sporangial wall, which distinguishes them also from every

related species of *Physarum* except *P. Braunianum*. There may be traces of stalks at times, but I doubt it, and more likely, they are cases where a sporangium is perched by the center of the base upon a slight elevation of the habitat. *P. oblatum* is never sessile, except in imperfectly developed parts of an otherwise stalked colony, and the stalks are always long enough to indicate their character. A description of *P. oblatum* will be found in the present series of notes.

The capillitium of *P. auriscalpium* may be *Badhamia*-like occasionally, and may be mistaken then for *Badhamia decipiens* (Curt.) Berk., but the latter species is always yellow, does not have the speckled appearance of *P. auriscalpium*, and resembles more the imperfectly developed, sessile phases of *P. oblatum*, which however are rare.

There remains the question that Cooke's specimen from South Carolina may be an imperfectly developed, sessile form of *P. oblatum*. In that case a name must be given to the present form which is not *P. oblatum* nor *B. decipiens*.

PHYSARUM BRAUNIANUM de Bary; Rost. Mon. 105. 1875.

Sporangia sessile, subglobose, 0.3 to 0.5 mm. diam., scattered or clustered but not heaped, not rugose, brown or reddish brown, speckled with many pale spots, sometimes without lime and then uniformly purplish brown; sporangial wall membranous, yellow, with separated included clusters of white or pale yellow lime-granules, often streaked with red; capillitium a network of hyaline threads with numerous small, angular or branching, white, yellowish, or brownish lime-knots; spores violet-brown, spinulose, 8–10 μ diam.

The form is mentioned in the first edition of the Lister Monograph on page 63 with a description in English. In the second and third editions it is regarded as synonymous with *Physarum lateritium* (Berk. & Rav.) Morg., and figured in both on plate 61, fig. d. A comparison of the figure with that of *P. lateritium* on plate 60 is almost sufficient to show they are different species. *P. Braunianum* differs from *P. lateritium* in the much smaller sporangia and absence of plasmodiocarps; the angular lime-knots without red centers; and the sporangial wall, which in *P. lateritium* has an outer crust of scarlet or yellow lime-granules, lightly

affixed, and breaking away in fragments from the inner, membranous wall.

There are sixteen collections of *P. Braunianum* in the Herbarium of the New York Botanical Garden personally made in the States of New Hampshire, New York, and Pennsylvania, and six more by other students in Massachusetts, Florida, and Pennsylvania. All are constant and uniform in the characters given. The differences between them and the type material of *P. lateritium* collected by Ravenel in South Carolina (N. Y. B. G. No. *11566*) are so pronounced, that it is strange the two forms were ever united. The true *P. lateritium*, common in eastern North America, is probably rare in Europe, or not well understood, and it seems to have been the practice to regard specimens of *P. Braunianum* as representing the species. Two specimens here, found by Mr. H. J. Howard in Norfolk, England, and perhaps from the same collections mentioned by Lister (Mycetozoa ed. 3. 64. 1925) are *P. Braunianum*. No specimens of the true *P. lateritium* are here from any European correspondents.

PHYSARUM GILKEYANUM Gilbert, Am. Jour. Bot. **19**: 133. 1932.

No specimen has been seen. The species is based on a single colony of about 75 sporangia found in Oregon in March. The description and figures, with the sporangial shape, the wall with ridges, the persistent capillitium, the more abundant lime in the lower part of the capillitium, the spores, and the habitat, all in combination are strongly suggestive of a slightly abberant, but representative phase of *Physarum mutabile* (Rost.) Lister. The latter species is extremely variable, particularly in form and lime, but the persistent capillitium seems to be present in every collection.

PHYSARUM LEPIDOIDEUM Gilbert, Am. Jour. Bot. **19**: 133. 1932.

A specimen has not been seen. The species is based on a single collection made in Oregon in January, and upon the rounded scales of lime in the peridium, similar to those in the genus

Lepidoderma. Specimens with such scales are frequently found in several species of the calcareous genera other than *Lepidoderma*, and are due to wet or cold weather at the time of fruiting. They are rather common in the forms grouped around *Physarum notabile* Macbr., which includes *Physarum compressum* Alb. & Schw. *P. lepidoideum* is probably a sessile phase of *P. compressum* in which the lime has been altered by moisture. The effect may be produced experimentally by re-wetting some sporangia of *P. compressum* or *Diderma effusum* so that the lime is dissolved, and on again drying, the lime will often form in vitreous plates. The lime in the expansions of the capillitium of sessile phases of *P. compressum* is also occasionally vitreous and transparent.

PHYSARUM NEWTONI Macbr. Bull. Nat. Hist. S. U. Iowa **2**: 390. 1893. The original description by Macbride is as follows:

Sporangia simple, gregarious, short stipitate or sessile, globose or flattened, when not globose depressed and deeply umbilicate above, purple, smooth, thin-walled, stipe when present very short and concolorous; columella none; hypothallus none; capillitium abundant, delicate, with more or less developed nodules, which are also concolorous; spores by transmitted light, dark brown, thick-walled, rough, nucleated, about 10 μ.

The description is based on the type collection from Colorado which I have not seen. Two specimens from Japan, determined as the species by Prof. Emoto, differ materially from the description of the Colorado collection. The sporangia are purple, globose, 0.6 mm. diam., on stalks 0.6 to 0.8 mm. high, arising from a circular hypothallus. The sporangial wall is rough with many large clusters of purple lime-granules and refuse matter, thicker near the base, and persisting for nearly half the height of the sporangium. There is no columella. The capillitium has delicate branched, pale violet threads, attached to the sporangial wall and converging inward, with many irregular, purple lime-knots. The spores are purplish red, irregularly spinulose, 8–10 μ diam.

It is possible the Japanese forms may represent a different species, or the description of Macbride may be deficient, based as it is on a single collection. N. Y. B. G. Nos. *7381*, *8809*.

PHYSARUM OBLATUM Macbr.

Sporangia stalked, globose or subglobose, 0.4 to 0.6 mm. diam., yellow or pale yellow, roughened; sporangial wall membranous, yellow, with innate, closely set clusters of yellow or pale yellow lime-granules; stalk erect, slender, furrowed, 0.3 to 0.8 mm. high, reddish brown, translucent; capillitium of many angular and branching yellow or pale yellow lime-knots connected by fairly long threads, sometimes a *Badhamia*-like network; spores violet-brown, spinulose, 9–12 μ diam.

Physarum ornatum Peck (Rept. N. Y. State Mus. **31**: 40. 1879) is probably the same form. I have examined the type specimen in the New York State Museum, and while only stalks remain, they appear to be the same as those of *P. oblatum*, and the description of Peck, together with the fact that *P. oblatum* is common in New York, leads me to this belief. In view of the uncertainty, however, it is better to retain the later name of Macbride until a perfect and authentic specimen of Peck is uncovered.

P. oblatum is common on cottonwood poplar forming small colonies. *Physarum Maydis* (Morg.) Torr. is no more than a small phase found on other habitats, such as piles of decaying vegetable matter, twigs, and manure. There is nothing but size to differentiate it from *P. oblatum*. Many species, normally stalked, occasionally produce sessile sporangia. This happens rarely in *P. oblatum*, as the form seems to reach perfect maturity under nearly all conditions. Occasionally a few sessile sporangia, poorly developed, may be found associated with stalked ones. These sessile forms, when the capillitium is more *Badhamia*-like, will resemble sporangia of *Badhamia decipiens* (Curt.) Berk., but in the latter species, which is rare, plasmodiocarps predominate.

PHYSARUM PERFECTUM M. Peck, Am. Jour. Bot. **19**: 134. 1932. No specimen has been seen. The author says various features suggest *Physarum melleum* (Berk. & Br.) Mass., but the color and greater size distinguish it. It is probably no more than a pale, robust form of that species. Similar forms are found in any large series of specimens of the latter form from different localities, as we have here.

PHYSARUM PEZIZOIDEUM (Jungh.) Pav. & Lag. Bull. Soc. Myc. Fr. **19**: 87. 1903. (N. Y. B. G. No. *11236*, authentic material.)

There seem to me no reasons whatever for keeping this species in a distinct genus, *Trichamphora*, as Junghuhn (Fl. Crypt. Jav. 12. 1838) proposed. It is not only closely related to *Physarum javanicum* Racib., but in some instances the two forms are almost identical except for the stalks, and surely these are not of generic importance. There is not a single, worthy character to distinguish *Trichamphora* from *Physarum*, and both species belong in the latter genus.

PHYSARUM SIMPLEX M. Peck, Am. Jour. Bot. **19**: 136. 1932. No specimen has been seen. The author says it is related to *Physarum flavicomum* Berk. The description and figure indicate it is a phase of that species or *Physarum tenerum* Rex, with the slight variations often present in either species.

PHYSARUM SUPERBUM Hagelstein. A large, finely matured collection of this handsome species was made by young Robert H. Rispaud at Mineola, Long Island, in August. The development appeared on a pile of dead leaves in the back yard of a house close to the home of Mr. Rispaud Sr. N. Y. B. G. No. *2155*.

STEMONITIS CONFLUENS Cooke & Ellis. Collections of this species were made at Mitchell Field, Long Island, New York, in September and October. It was again on oak bark, although now on the outside. N. Y. B. G. Nos. *2158*, *2227*.

TRICHIA LUTESCENS Lister. In late August, there appeared on the bark of one of the logs at Mitchell Field, Long Island, the wood of which could not be determined, numerous solitary sporangia of this species, widely separated, and generally an inch or more apart. A few were in small groups of from two to five. The sporangia are sessile, globose or bolster-shaped, pale olivaceous brown, showing the impressions of the inner spores, sometimes slightly iridescent, 0.2 to 0.5 mm. diam. The sporangial wall is thin, membranous, yellow, translucent, almost free from granular matter. The capillitium consists of long, simple elaters with little branching, and terminating in short, pointed tips, blunt or bulbous ends. The spirals are distinct and in addition there are short, broad, blunt spine-like processes scattered along the elaters. There is considerable variation, however, in different sporangia. The spores are olivaceous in mass, pale yellow by transmitted light, and measure about 10 μ.

The species has been rarely reported from North America, probably because of the scattered habit, which makes it impossible to recognize in the field. The olivaceous color of the spores in mass may be a means of separating it from phases of *Trichia contorta* (Ditm.) Rost., if other differences are obscure. This may not be a constant feature. N. Y. B. G. No. *2190*.

THE NEW YORK BOTANICAL GARDEN

NOTES AND BRIEF ARTICLES

The Polyporaceae of New York State (except Poria)

This paper, issued in 1942 as Technical Bulletin no. 60 of the New York State College of Forestry, Syracuse, New York, is a revision of bulletin 41 (1934) with a somewhat similar title. The bulletin consists of 128 pages and includes illustrations, keys to and descriptions of 8 genera and 141 species, a glossary, citation of literature, and an index. Under each species a relatively complete listing of synonyms, illustrations, and pathological literature are given. The pathological literature in foreign languages has been covered as completely as possible. Although the descriptive matter is complete, the keys and descriptions were made as simple as possible, to meet the needs of beginning and occasional students of the group. The bulletin is available from the Extension Department of the New York State College of Forestry at the actual cost of printing, 45 cents per copy—Josiah L. Lowe, author.

A New Mushroom Book

"Common Edible Mushrooms" by Clyde M. Christensen of the University of Minnesota, is the latest contribution in this fascinating field. With many of the older works out of print this one will be welcome.

This work is designed for beginners, and after a general discussion of mushrooms the author discusses what he calls "The Foolproof Four": the morels; the puffballs; the sulphur polypores; and the shaggymanes. These anyone can recognize and eat with impunity. Then some of the more difficult forms are treated, the reader being constantly warned that only those should be eaten, the identity of which is certain.

The neatly bound volume consists of 124 pages including bibliography of other works on mushrooms and index. There are 62 figures and 4 colored plates. It will be found exceedingly useful. —F. J. Seaver.